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TABLE OF LEADING ARTICLES.

The Contractor's Number. 229
Contracting and Engineering.................. 229
The Camera on Construction.................. 230
The Panama Canal.......................... 230
The Simplon Tunnel......................... 231
The Responsibility of the Constructing Engineer 232
Gravity Tunnel for the New Water-Works of Cincinnati. (Illustrated) 232
The Cumberland Extension of the Western Maryland Railroad—I. (Illustrated) 236
The Erection of the Blackwell's Island Bridge—I. (Illustrated) 239
The Construction of the Charleston Dry-Dock. (Illustrated) 242
The Erection of the Missouri River Bridge at Plattsmouth, Neb. (Illustrated) 245
Safeguards for Laying Concrete in Frosty Weather. (Illustrated) 249
Construction of the Port Morris Power House for the New York Central R. R. (Illustrated)..... 250
The Reconstruction of the Portage Viaduct. (Illustrated) 252
Reconstructing Piers of a Railroad Bridge in Service. (Illustrated) 254
The Construction of the Steel-Concrete Shops at Beverly, Mass. (Illustrated).............. 257
Track-laying on the Williamsburg Bridge. (Illustrated) 261
Construction of the Thebes Bridge Piers. (Illustrated) 263
Reinforced Concrete Piers of the Gilbertsville Bridge. (Illustrated) 265
Construction of the Schuylerville Concrete Dam and Power House. (Illustrated)........... 266
The Erection of the Quebec Bridge. (Illustrated) 268
Completing the New Croton Dam. (Illustrated).. 274
Concrete Piles at the U. S. Naval Academy. (Illustrated).... 277
The Robert Gair Reinforced-Concrete Factory and Warehouse. (Illustrated) 279

The Contractor's Number.

It has been stated many times in these pages that the construction of engineering works is of almost equal importance to their design. While the best of workmanship and materials cannot overcome the bad effect of imperfect designs, poor construction will often prevent in a large degree the good that skilfully prepared plans ought to accomplish. It has seemed desirable, therefore, to emphasize at this time, when plans for the coming season's operations are being outlined, the importance of the construction side of civil engineering. This issue of The Engineering Record is accordingly a contractor's number, and contains descriptions of a large variety of undertakings, some of them being the most important of their class in recent years. Even a hasty examination of the following pages will show how essential it has become to employ all the resources of engineering in carrying out the plans for works of any magnitude.

In such enterprises success depends mainly on organization and plant. Organization cannot be taught in schools, but must be learned in the field. The successful field executive has half his mind fixed on the object to be obtained and the other half concentrated on his expense account. The country has plenty of men who can do good work if they are not hampered by limits to the time and money they may spend. But the men who accomplish the desired results with the least expense are not easy to find. They are off on work and not hanging about the cities looking for jobs. A great many more of them are needed; this journal believes that the technical schools are furnishing the material for them, provided proper recognition is given in the plan of instruction to the engineering done outside of the headquarters' office. One of the gratifying indications of this is the growing number of young graduates who seek employment preferably with contractors, in order to acquire as soon as possible that familiarity with the method of carrying on construction which is only to be gained with the actual builders of bridges, tunnels, railways and other works. This journal is doing all that any publication can to furnish its readers with information concerning the way in which these undertakings are carried on, but, of course, it cannot supply the intuitive grasp of a problem which comes from personal acquaintance with such work, and personal responsibility for organizing and managing part or all of the force for executing it.

Along with organization must be classed equipment, and on this subject the readers of this journal have been kept well informed. With the advent of the engineer in the field of contracting came a demand for well-designed plant, and some of the equipment employed today is very interesting. At the risk of seeming to some to descend from the dignified altitudes of editorial infallibility, it will be acknowledged that it too often happens news concerning novelties of this character first appears in the section of this publication controlled by the advertising department. In fact, it may be said that the only journalistic "scoops" against the editorial department appear in that section; luckily the reader loses nothing by this, although those responsible for the reading pages may feel some disgust at being outclassed by home talent. The data furnished by this journal concerning contractors' plant are believed to form one of its most valuable features. It is not surprising that such good plant is now made, because it is often designed originally by contractors' engineers, who sell the patents to the manufacturers.

Contracting and Engineering.

The technical schools report each year that there is a demand for more young graduates than they can supply. It is therefore likely that for the present the senior in such a college can make some choice in his selection of his first work. But with the steady increase in the number of students in these institutions there is a corresponding approach to the time when technical education will cease to insure an engineering engagement immediately following graduation. This increase in their numbers indicates the advantage to some young engineers of becoming contractors. Twenty-five years ago such a career would have been regarded as a step downward, but nothing of the sort is true to-day, when many of the leading members of the national engineering societies are engaged in this pursuit.

The average engineering work requires two classes of ability, one which is strongest in planning, and the other strongest in construction. Formerly engineering knowledge was mainly concentrated in the first class. This resulted in costly construction, slow progress, and too often in poor results. Little by little the most progresive contractors grew to a realization of their defects. They were able to handle labor and to execute work of some grades with entire succes. But where there were serious difficulties to be overcome or expensive plant was required, their lack of accurate technical knowledge was a serious handicap. Accordingly, they employed engineers to assist them. In the early days these men were sometimes the very poor ones who could find nothing to do in engineering corps, and consequently the position of the engineer in the contractor's organization was precarious and humble.

All this has now changed. There is none of the undertakings described in the following pages which is not a test of ability in construction as well as design, and in some of them the design depended to a considerable degree on the requirements of construction. The engineer and the contractor are working more and more closely, and while the engineer is compelled to regard the requirements of the contractor, the latter is absolutely forced to become an engineer himself. Consequently, it may be said that in a certain sense contracting is merely one branch of engineering. The truth of this observation is well shown by considering the contractor's duties in the light of the requirement of the American Society of Civil Engineers that its members must be competent to design as well as to execute works. Take, for example, the construction of the Croton dam. This work has required an enormous plant, and the engineering ability needed to install and operate it is on the same scale as that requisite in the average sewerage, water-works or factory undertaking. The erection of the Blackwell's Island and Quebec bridges also calls for marked talent in designing. It is hardly necessary to multiply examples to show the force of this view.

It is in the smaller works, however, that the young engineer has his greatest opportunity. Technical knowledge, ability to handle men, and common sense will show their worth more quickly in small work than in large, for a greater opportunity is offered for making individuality felt. A great deal of small work is now being done by people without any particular fitness for it, solely because the opportunities for profit in it have been overlooked by more competent men. One instance of this nature may be mentioned. An engineer was ordered by his physician to give up all hard work and to play for a time. An acquaintance own-ing a New York hotel asked him to look over certain of its electric fixtures. He did this for the sake of something to occupy his time. The acquaintance was so pleased with the repairs that he told the owner of an apartment house about them. In a little while the engineer had all the work he could attend to with the help of a few assistants; he was making more money that he had ever earned on a salary basis, and was doing this without any of the nervous strain of his former employment. Another recent case was that of a young engineer employed on some extensions of a small water-works plant. There was a complaint about the supply to one of the consumers and he was sent to investigate it. The trouble was due to the fertility in wrong-doing of the local plumber. This young engineer had picked up some knowledge of plumbing in a Chicago trade school and was personally able to rectify the defects. The fame of his achievement spread, and now he is a master plumber with a thriving business, all built up in a couple of years.

It may be said that such work is not so dignified, so high in character, as that of the engineer. Very likely it may not appear so to some people. The fact remains, however, that there is a need of good men to do the small work which is now left to the care of the "practical expert" who is only competent to botch things. The best water-works system is reduced in value if the plumbing in the houses is poor, the success of a sewerage system depends in no small degree on the way it is laid and the houses are connected to it, and the heating plant of buildings must be conscientiously installed if the occupants are to keep warm. To take up such work may seem equivalent to throwing away a technical education, yet the time is fast coming when people will appreciate and willingly pay for technical knowledge among the contractors for such construction. It must be remembered, moreover, that the man usually achieves most success as a contractor who commences with small things and proves by his ability in executing them that he can handle the larger ones. Such a man can reasonably count on securing financial backing which would be refused to those trying to start pretty high up on the ladder.

The Camera on Construction.

The recent explanation in this journal of the method of conducting topographical surveys in Canada by means of the camera has brought so many letters of inquiry concerning the details of the work that it is necessary to refer readers to the author of the paper, Mr. Arthur O. Wheeler, of Calgary, Alta., Canada. It would be well, however, to avoid bothering that gentleman with requests for information concerning ordinary photographic manipulations, as there is a limit to the correspondence which one engineer is justified in inflicting on another, and some of the inquiries sent to this office can be found answered in detail in many books prepared for the amateur photographer. It is gratifying to observe, however, that there is a widespread and hearty appreciation of the value of a camera in general engineering work.

It has been widely recognized that the best way of keeping a record of the progress of construction is by the camera. Views taken once a week are often called for by engineers, but it is not so generally recognized by contractors that views taken at shorter intervals are well worth having on some kinds of construction. No contractor is able to be on all parts of an undertaking at all times, and he frequently must be absent at times when the construction is at important stages. The camera gives him a means for keeping in touch with the work at such times, and its use need not interfere with the men. In fact, one of its chief advantages lies in the fact that views will often indicate, when carefully studied, possible improvements in the routine or plant. Such uses of photographs are somewhat novel, to be sure, but they have proved worthy of consideration. It is hardly necessary to point out the great value to the contractor of complete photographic records of the progress on work where there is likely to be any differences of opinion concerning the equipment and force or the rate of advance. A series of views of this character affords the best proof of a contractor's desire to carry out his work properly, and is sometimes a complete answer to the complaints sent to chief engineers by young inspectors unacquainted with all the problems which arise in handling a large undertaking.

It must be understood, however, that the contractor who endeavors to take a series of good views with a camera obtained for fifty trading stamps at the corner grocery is likely to be disappointed. So many poor contraptions are sold as cameras that care should be taken to secure an instrument fitted for the given class of work and provided with a lens which will give a clean negative. A little money paid to obtain a proper outfit will be well worth spending in many cases, while a little money saved by the selection of an inferior outfit may render the whole investment a loss. It is sometimes possible to pick up bargains in such things, but as a rule the second-hand instruments are not good for much and the low-price apparatus are incapable of good work.

The Panama Canal.

The admirable report of the engineering committee of the Isthmian Canal Commission, which is printed in full in the Current News Supplement of this issue, is one of those important documents that every engineer, no matter what his specialty may be, should read and consider. It explains those features of the canal problem which have been under investigation, and makes clear the great detail of some of the investigations which were needed before any plan for this great work could be drawn up in the way it should be. The Commission has been criticized for doing nothing, but to do any more than has been accomplished would have been to rush ahead into a project with the same lack of plans which brought the first French company to disaster and disgrace. The critics of the Commission have neglected to consider that until very recently there were not enough positive facts available concerning the working conditions at the Isthmus to enable anybody to determine with certainty what plans should be adopted. The report now published is conclusive in its statement of facts, gathered by the best engineering organization ever brought together for such work. The deductions of the committee from those facts will have the approval of most engineers, but what action Congress may take is hard to foresee. Had that body more sympathy with the Commission's desire to be sure of its premises before adopting recommendations, it is not unlikely that the sea-level project would find ready support, but in view of the feeling which recently manifested itself it may be possible that Congress will carry its opposition to the Commission so far as to reject its suggestions.

There are two features of this report which deserve comment. The first is the statement that much of the work can now be started at any time and the plans for it can be drawn up by Chief Engineer Wallace without regard to those features of the whole project which must await the action of Congress. Such, for example, is the improvement of the harbor at the Atlantic end of the canal. This is a work which manifestly ought to be started immediately, for a harbor is now needed to protect the vessels bringing supplies for the canal work, if for no other purpose. This shipping in itself will soon become of no small amount, and the harbor works ought to be started so that no delays in the canal work will be caused by such stormy conditions as the committee describe in their report.

The second feature of the report which deserves careful attention is the recommendation for a sea-level canal. This project is stated to be the one favored by Mr. Wallace, and has everything to recommend it in view of the low cost at which excavation can be carried on at the Isthmus. There is, of course, a limit to the amount of money the government is justified in sinking in such an investment. But if a sea-level canal can be constructed at the figure stated in the committee's report, it offers great advantages, which do not depend solely on the increased navigability of a tidal canal, important as that is. The leading merit of such a project lies in the practicability of deepening and widening the canal whenever it should become necessary. The improvement of a lock canal in this way is very difficult, while in the case of a tidal canal the difficulties disappear. It is only necessary to look at the constant deepening of the harbors of the country made necessary by the steady increase in the draught of ships, to recognize that it is impracticable to look very far into the future in this respect. All that can be done is to provide for greater depth and width when it becomes necessary, and this is best done by a sea-level canal.

Another feature of the report which is most gratifying is its indication of manifest harmony between the Commission and its chief engineer. Probably no engineer has ever been placed in a position of such delicacy as that thrust upon Mr. Wallace by some of the newspapers of the country. Throughout the whole miserable newspaper campaign of misrepresentation, he has acted in a manner which makes those who have the welfare of the canal project close to their hearts rejoice that he accepted the position of chief engineer of the Commission. That body and that engineer are working in harmony, and have worked in harmony; if through act of Congress the Commission is altered or abolished, it will not be because its engineer has been disloyal to it or to the canal. It is safe to say that no one act that the members of the Commission have done has been more satisfactory to them than the selection of the eminent engineer who is now directing affairs on the Isthmus. So much misrepresentation and misstatement have marked this feature of the Commission's work that a statement of the facts in the matter seems needed.

The Simplon Tunnel.

The meeting of the two main headings of the Simplon tunnel on Feb. 24 was one of the most interesting events of recent times and very properly resulted in an international exchange of congratulatory telegrams between the governments of Switzerland and Italy. The work is a triumph of Swiss and German engineering and of German financing, carried out in the face of great obstacles. So many articles concerning the enterprise have appeared in these pages that it is hardly necessary to point out now more than two features of the work. The first of these was the extraordinary trouble due to the high temperature at which parts of the work had to be carried on. The tunnel is covered so deeply in places by the mountain above that the natural temperature of the rock is very high, a record of over 130° Fahr. having been observed. This was foreseen and partly provided for, but as the headings advanced it was found necessary to make many changes in the plans for cooling and ventilation. The original plan of driving a parallel working tunnel proved successful and will remain one of the most interesting innovations in work of this class, while the methods adopted for handling water under heavy pressure for use in the drilling machines have attracted widespread attention.

The second feature of the work which deserves special mention was the difficulty which was caused by the presence of large quantities of very hot water. The history of this struggle against hot springs has been told in minute detail in some of the foreign technical publications and proves the truth of the mediaeval miners' adage that underground springs should be expected in the places where their presence will cause most trouble. They certainly caused a great deal of difficulty at the Simplon, and the way in which the engineers overcame them is a very plucky story of hard work against almost insuperable obstacles.

The most interesting result of the work has been the proof it affords of the great progress in tunneling since the days when the Mt. Cenis tunnel was one of the wonders of the time. That famous undertaking was child's play to the boring of the Simplon tunnel, and a comparison of the plant employed on the two undertakings shows very forcibly that the success of the latest enterprise was due in no small measure to the great improvement which has taken place in all kinds of tunneling apparatus. This is not alone in drills, but also in pumps, electrical apparatus, air compressors, ventilating apparatus, rolling stock and explosives, to mention but a few classes. It is this improvement in plant which enables so much manual labor to be replaced by machinery not subject to the oppressive influence of high temperatures, dampness and fatigue. While a large part of the equipment used at the Simplon tunnel was of special design, the fact remains that the greatly increased resources of contractors for such work are largely due to the excellent machinery produced by manufacturers making a specialty of equipment for tunneling.

The Responsibility of the Constructing Engineer.

Many of the articles in this issue of The Engineering Record prove a point occasionally raised by this journal without very much apparent result. This is the lack of recognition paid to the engineers who are put in charge of the construction of important works. It frequently happens that a large amount of money will be spent in the preparation of plans, but little or no care will be taken to see that they are properly carried out. The fact that so much good work is done speaks well for the contractors and the underpaid and overworked engineers who act as resident supervisors. Too often nothing at all is done in the way of inspection except by some local mason or carpenter out of a job and willing to supervise construction, of which he knows next to nothing, at cut-rate wages. Probably one reason for this is the custom of charging the resident engineer's salary to the people for whom work is being done, as an extra charge to the expense of the engineering and supervision which the designing engineer usually agrees to furnish. This practice is so well fixed that it seems useless to change it, even if a better one could be suggested. At present the best remedy seems to lie in the hands of the engineers who prepare the plans and exercise such supervision as they can give in a visit every two weeks or so. This remedy consists of very plain talk to their clients about the necessity of having a good resident engineer on the work to co-operate with and help the contractor when he is doing well, to check him when he is doing badly, and to keep the designer of the work in constant touch with everything that goes on.

These resident engineers, living very often in a rough way which would make a city dog discouraged, forced to work longer hours than the contractor's men, compelled to take all the kicks from every source and smile pleasantly meanwhile, deserve greater consideration. More than once large sums of money have depended on their tactfulness and keen judgment. Their readiness to provide remedies for serious conditions may be of great value at times, and their ability is often the crucial point on which hangs or falls the success of a project for the time being. These men must have technical knowledge, good judgment, tact in their intercourse with all classes of men, absolute integrity and the constitution of a truck horse. Most people will admit this, and yet when it comes to paying them the salary they deserve there is a chilly temperature in the air and a marked drop in cordiality. In view of the poor wages and great responsibilities of such positions, it is not surprising that at one time the right class of men refused to take them and they were filled with a class of temperamental grafters. With the increase in the number of graduates of technical schools these bribe-takers have been gradually disappearing in favor of fine young fellows, but their presence has left a bad reputation for their successors to live down. As the condition now stands, the resident engineers on construction are an excellent class in danger of being forgotten because they are out of sight and attending to their duties quietly and efficiently.

Another class of engineers engaged on construction is that sent out by manufacturing companies to put up machinery. This class is also improving, but its importance to the good name of its employers is not yet properly recognized. A company will spend large sums in the drawing room and shop to bring out some expensive machine and will then entrust its erection to men drawing little more than a foreman's salary. It is surprising at times to observe the responsibility these erection superintendents have to carry. More than once it has come to the knowledge of this journal that machinery was sent out containing some serious defect, and it was only through the designing ability of the erection manager that this defect was repaired without attracting attention and the machine set up ready for successful operation. The good name of the makers rested not only on the ability of these men to do their nominal work, but also that of men drawing much higher salaries. In these days of keen competition, the expense of erection is an item to be regarded with great care, yet the task of keeping that expense down is assigned to men paid at a rate which does not draw to the headquarters offices people who are considered capable of reducing expenses. As it is, these construction superintendents and engineers are expected to live a homeless life, with little chance of being with their families for more than a few days in the year, to make good all the defects of the shop, to keep on terms of peace with the representatives of other contractors, and to do their work at a very low cost to their employers and a very low salary for themselves. The last feature is the worst of the list. Little by little, manufacturers are coming to recognize that the people doing their work outside their shops have a considerable effect in moulding opinion concerning their product, and to recognize the value of representation by erecting engineers as well as salesmen.

Notes and Comments.

SEWAGE DISPOSAL EXPERIMENTS will be made by the city of Waterbury, Conn., before finally adopting plans for purification works. The importance of the investigations made in Columbus has convinced the Waterbury authorities that a thorough preliminary study of the character of the sewage is necessary to enable the works to be planned to the best advantage.

THE SEVERN TUNNEL PUMPING PLANT consists of 14 engines and pumps having a total pumping capacity of 79,200,000 gal. in 24 hours. According to Mr. Nicholas J. West, in his inaugural address as president of the Society of Engineers, of London, who was connected with the installation from its commencement for 13 years, the quantity dealt with under ordinary circumstances varies from 19,200,000 to 40,800,000 gal. in 24 hours.

LIGHTING IN FOGS has been specially provided for in Westminster, London, by using portable compressed-air flaring oil lamps at central points to guide traffic during severe fogs. It is stated that their flames appear to emit a rather large proportion of yellow and orange rays, penetrating farther into a fog than rays of other colors. Orange-tinted globes and special carbons for arc lights have been tested by Mr. J. W. Bradley, engineer of Westminster, in his search for some light which will penetrate the London fog.

CONVICT LABOR on public works has as many opponents as advocates, yet there are certain classes of construction on which such labor has decided advantages. Such work as the clearing of a reservoir site, which is being done by county convicts for the Atlanta water-works, is open to few of the objections usually raised against such labor. Such work is ordinarily done by non-residents of the city, and hence no residents are deprived of employment, and the convicts are employed in localities where their presence is not objectionable.

RAILWAY PROTECTION AGAINST SAND STORMS has been attempted in various ways in the case of the transasiatic line extending from Krasnowodsk, on the Caspian Sea, to Taschkent, the capital of Russian Turkestan. The railway traverses great stretches of sand plains, where it has frequently been damaged and sometimes entirely destroyed. Among the methods adopted with success, according to the "Oesterreichische Wochenschrift für den offentlichen Baudienst," has been the clay revetment of the railway embankments and adjacent surfaces, but particularly the plantations, so to speak, of tamarisks, wild oats and the like. These have been employed largely between certain stations, where for a width of 1,740 ft. more than 840 acres have been planted.

THE OWNERSHIP OF DRAWINGS and other data made by a city engineer while he was acting in a private capacity has been settled by a decision of the Colorado Court of Appeals. In 79 Pac. Rep. 327, the decision is summarized as follows: An ordinance requiring the city engineer to inspect and pass upon the construction of all public works and to do the surveying and engineering ordered by the city, and requiring him to preserve all plans and documents pertaining to his office, and to deliver them to his successor, does not require him to turn over to his successor books containing field notes made by him in surveying lots of individual owners upon their application, under their employment and at their expense, but such books are his private property.

GRAVITY TUNNEL FOR THE NEW WATER-WORKS OF CINCINNATI.

By J. A. Hiller, Assoc. M. Am. Soc. C. E., Resident Engineer.

In the new system of water-works under construction for the city of Cincinnati, the supply is taken from the Ohio River near the Kentucky shore, opposite the village of California, Ohio. It is conveyed from the intake pier by a tunnel under the Ohio River to the Eastern Pumping Station, where it is forced to the subsiding or settling basins. From these basins it flows, by gravity, through the filtration plant and the clear well into and through the gravity tunnel.

The gravity tunnel is the conduit for the conveyance of the total supply of the filtered water from the purification works, near the village of California, to the Western or Distributing Pumping Station, in the eastern part of the city. The total length of the tunnel is 22,264.11 ft., practically four and one-quarter miles. The general alignment is about parallel to the Ohio River, and at a distance 300 to 1,000 ft. from it, as indicated in the plan.

The average depth is about 130 ft. below the ground surface and about 25 ft. below the surface of bed rock. The tunnel through its entire length is in a limestone and shale formation in nearly horizontal strata, containing water to a greater or less extent. The grade of the tunnel is 1 ft. in 2,000 ft., descending from the clear well toward the pumping station end. The profile of the gravity tunnel shows its location relative to the ground surface and the top of rock.

At the two extremities are located the permanent shafts, Nos. 1 and 5. Originally it was intended to use the permanent shafts and three working shafts for the construction; subsequently, after about 500 ft. were driven from Shaft No. 1, it became necessary, owing to other work, to abandon work at this heading. In order not to delay the completion of the tunnel, an additional working shaft (No. 6) was sunk at a point about 1,000 ft. from Shaft No. 1. There was thus a total of ten headings in which the construction of the tunnel was executed.

Survey of the Surface Line.—The alignment of the tunnel not being a continuous tangent between the shafts, but being broken by one or two angles between, it became necessary to make a very careful survey of the surface line to establish the true position and magnitude of the angles.

The centers of the shafts and the angle points were established from the preliminary survey line, then the tangents and angles were measured.

Between Shafts 1 and 2 the line traverses a comparatively thickly built up portion of the city. Tangent 1 passes through a frame dwelling, and to obtain the line between Shaft 1 and angle 1, the transit was set up on a chimney of this house, shifted into the line, and from this position permanent points were fixed on both sides and foresights established.

Tangent 2 passes through the machine shop and retort house of the East End Gas Works, and the office, stable and coke piles of the Marmet Coal Co. With these obstacles on the line, it was found impossible to get the instrument at any point where the two extremities of the tangent could be seen. A transverse line was run, beginning at angle 1, running to angle 2 and returning by another route to angle 1. This was a closed survey, which was divided by tangent 2 into two parts, which, when considered separately, gave tangent 2 as the closing line for each part.

The results obtained from three trials of this traverse are given in Table 1, each result being the mean found by considering each part:

TABLE 1.—Measurements of Tangent 2.

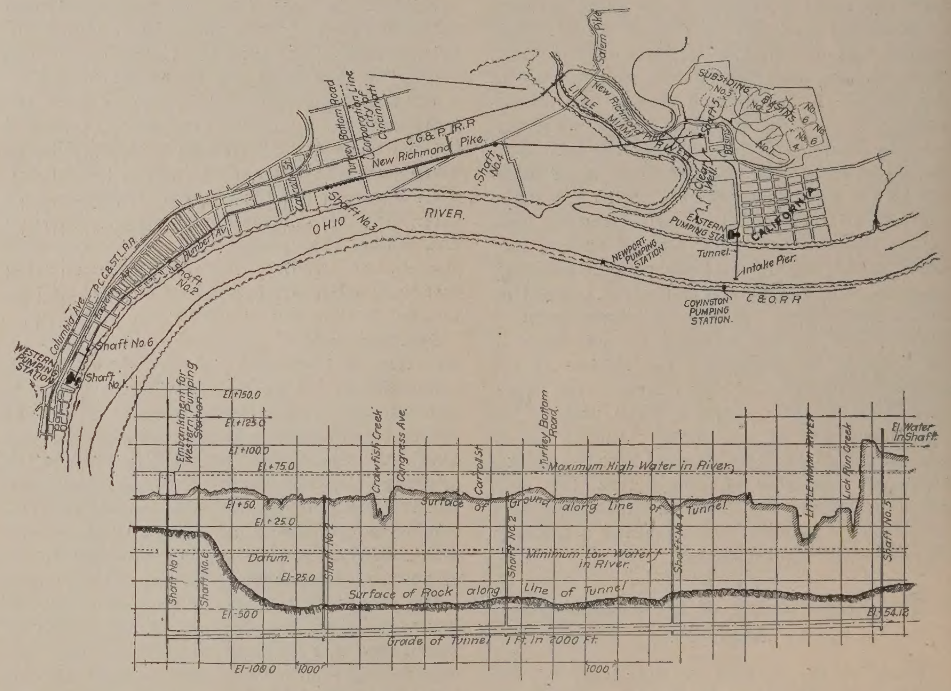
No. of trial.	Length of tangent 2.	Size of angle 1.	Size of angle 2.
1st	1314.5920	15° 27′ 32.1″	9° 08′ 45.9″
2d	1314.5892	15° 27′ 11.4″	9° 08′ 43.1″
3d.	1314.5871	15° 27′ 14.6″	9° 08′ 49.9″
Mean	1314.5895	15° 27′ 19.4″	9° 08′ 46.3″

On the third tangent there was one building and a pile in a tramway; a perpendicular offset line passed these obstructions.

The remainder of the tangents offered no obstacles which could not be overcome by the erection of foresights from 10 to 20 ft. in height.

The crossing of the Little Miami River was made by triangulation, using a quadrilateral, one of whose diagonals was the tunnel line.

The measurements of all tangents was made with a 50-ft. steel tape, which was ascertained to be correct at 60° Fahr., with a pull of 14 lb. Stakes were driven along the line every 50 ft. and at breaks in the ground, the line was marked thereon, levels run to establish the differences of elevation of the stakes, the tape stretched and the length and the temperature of the air for each length was taken and recorded.



Map and Profile of Tunnel of New Cincinnati Water-Works.

Each tangent was measured forward and checked backward during the summer, and the whole operation repeated later during the winter. In case of any great difference a check measurement was made. Thus each line was measured at least four times under widely different weather and temperature conditions, with no accepted difference greater than one in about thirty thousand. A mean of all measurements was taken as the length of the tangents. These mean measurements did not differ more than one in about fifty thousand from any extreme.

The field data was tabulated for reduction to the horizontal distance and to a temperature of 60° Fahr.

The angles were measured by repeating each ten times, by three or more observers, and the average result of all observations was accepted as the most probable.

The bench levels were run from an established bench at California to near Shaft 1 and return. Benches were established about every half mile, and in the immediate vicinity of the shafts. Such parts of the line where the differences of the two runs were greatest, a check run was made and the mean differences of elevations used to determine the elevations of the benches.

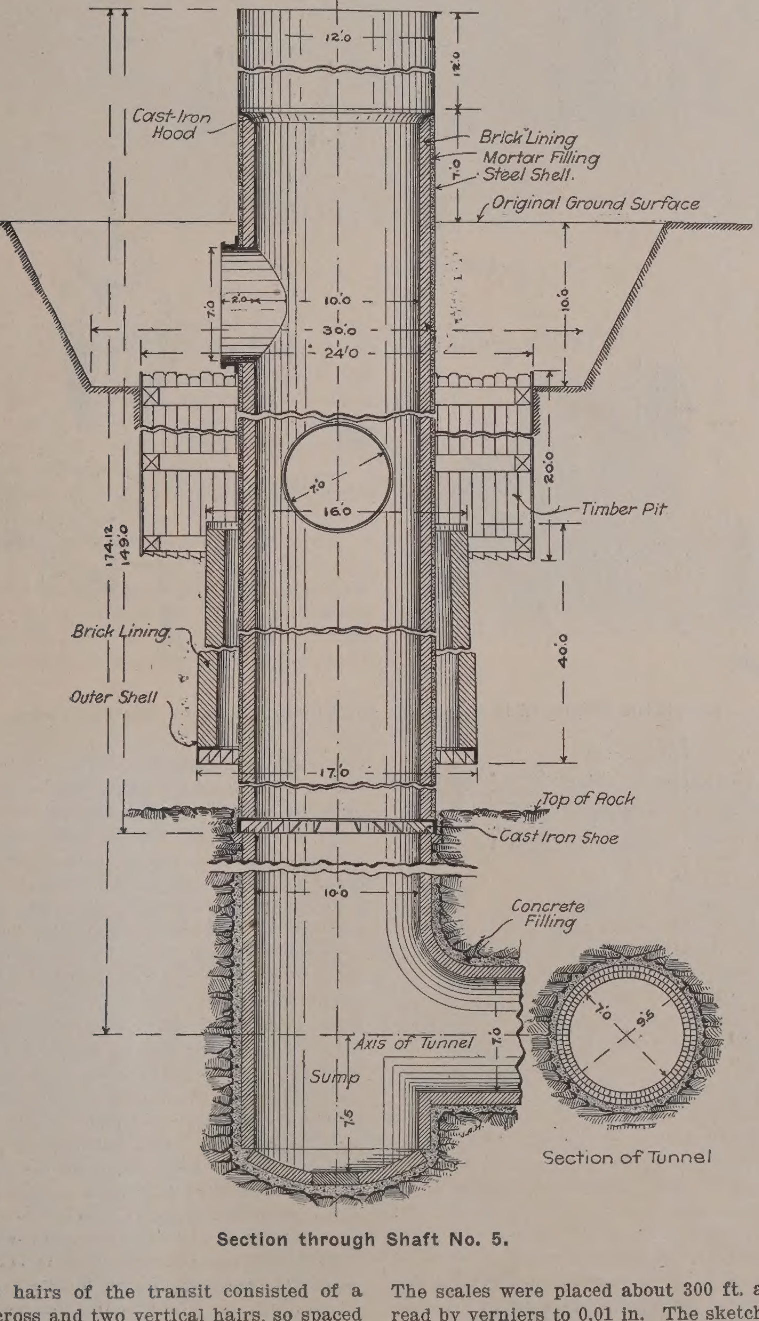
Transfer of the Alignment into the Tunnel.—At each shaft an observation station was erected for each tangent and foresights built at or near the distant angle points. These stations were so built that the observer's platform was independent of the transit support, and all enclosed in a small house to protect the instrument from sun and wind. The wires used for plumbing down the shafts were No. 5 piano wire, about one-sixtieth of an inch in diameter, held in a clamp at the top of the shaft in such a manner that the wire could be moved transversely by a slow motion screw, as illustrated. The method of securing the device to top of the shaft is not shown, as the local conditions at each shaft required a different arrangement. At the lower end of the wire was a hook, upon which was hung a cylindrical lead weight of 20 lb. The weights were suspended in glass jars containing glycerine. This arrangement permitted the weights being seen at all times and afforded absolute assurance that the weights hung free. Back of each wire was a small shield or background painted white; the lower end of the wires being blackened, showed distinctly against the white ground. The jar, nearer the tunnel transit, was supported on a small stand about 3 ft. from the floor, the farther jar rested directly upon the floor of the tunnel. This permitted each wire being viewed separately and allowed no chance or confusion of viewing the wrong wire. An electric light was supported so as to throw light upon the wire and background. The bottom of the wire, the weights, jar, background, stand and light are shown in one of the illustrations.

The tunnel transit was supported on a wooden strut secured against the tunnel arching by four large set screws, as illustrated. A tripod could not be used on account of the wooden floor being too springy for a secure setup.

The tunnel transit was provided with a slow motion arrangement whereby the whole transit could be moved a small distance at right angles to the tunnel line, allowing of very small changes in the position of the instrument.

TABLE 2.—DATA OF TUNNEL MEASUREMENTS.

Shaft.	Heading.	Date: Of beginning of of excavation.	Date: Of meeting of of headings.	Distances between —wires—	Length driven.	Error in alignment.	Error of levels.	Angles turned in each heading.
1	1	Dec. 26, 1900.	....	9 ft. 3 in.	478.3 ft.	....	....	0
..	..	....	Jan. 16, 1903.	.. ..	.....	1/16-in.	¼-in.	..
6	10	July 25, 1902.	....	8 " 0 "	541.3 "	....	....	0
6	9	July 25, 1902.	....	8 " 0 "	641.1 "	....	....	0
..	..	....	Oct. 17, 1903.	.. ..	.....	⅞-in.	⅝-in.	..
2	2	Dec. 21, 1900.	....	6 " 0 "	3,220.2 "	....	....	2
2	3	Dec. 21, 1900.	....	6 " 0 "	3,443.0 "	....	....	2
..	..	....	Oct. 28, 1903.	.. ..	.....	⅜-in.	1⅝-in.	..
3	4	May 11, 1901.	....	8 " 0 "	2,267.9 "	....	....	0
3	5	May 11, 1901.	....	8 " 0 "	2,686.7 "	....	....	2
..	..	....	Jan. 20, 1903.	.. ..	.....	5/16-in.	1¼-in.	..
4	6	June 5, 1901.	....	6 " 6 "	2,472.1 "	....	....	0
4	7	June 5, 1901.	....	6 " 6 "	3,507.1 "	....	....	1
..	..	....	Aug. 4, 1903.	.. ..	.....	1½-in.	¾-in.	..
5	8	Dec. 1, 1901.	....	9 " 3 "	3,006.4 "	....	....	0



Section through Shaft No. 5.

The cross hairs of the transit consisted of a diagonal cross and two vertical hairs, so spaced that they suspended about one-sixteenth of an inch at a distance of about sixty feet. This made the sighting of the instrument very exact, as the cross hairs and the plumb wire appeared white between, about equal to the diameter of the wire.

The operation of transferring the line into the tunnel consisted of setting a transit, in the observation station, on line by double foresights and bringing both wires to this line by means of the slow motion clamps. The tunnel transit was then brought into the line of the two wires and the line transferred to the scales, fastened to anchors in the masonry lining of the tunnel. The scales were placed about 300 ft. apart and read by verniers to 0.01 in. The sketch of these scales, with their fastening to the anchors, shows this arrangement clearly.

All necessary reversions of the transit were made to eliminate all probable errors of instrumental adjustment. Readings were made on the two scales and recorded for each position of the transit. Several independent trials were made, and in all about fifty readings were taken on each scale, in each heading, and a mean accepted as the working base line inside the tunnel. This line was extended into the tunnel as the excavations were advanced, always making the necessary reversions of the instrument and accepting the mean of all trials as the correct line.

The required distances from the shafts to the angle points were measured along the roof, using the same precautions as in the measurement of the surface line. The angles were turned by repeating several times. Afterward curves of 30-ft. radius were used for easing off the intersections. The angles being generally small, none of these curves were long, and little or no additional excavation was needed in order to place the lining on the curved line.

The levels were transferred into the tunnel by steel tape measurements down the shafts. Four to eight trials were made at each shaft and a mean result accepted.

Table 2 shows the distances between the wires at each shaft, the lengths driven in each heading, and the errors for closing for each meeting point.

The engineering department took samples of air from each heading daily and made tests for explosive gas. The daily progress of each kind of work in each heading was measured and recorded on a progress diagram. Samples were taken from each shipment of cement and tests made for soundness and tensile strength.

Lines and levels were given in each heading for every advance of about 100 ft. Holes were drilled in the roof about every 30 ft. and plugs driven, containing a small staple in the true line. The distances from the plug to the axis of the tunnel were computed and a list given to the heading foreman for his guidance in pointing the holes when drilling. These same grades were afterwards used when setting invert forms. The spring line grades were marked on the invert for setting the arch centers.

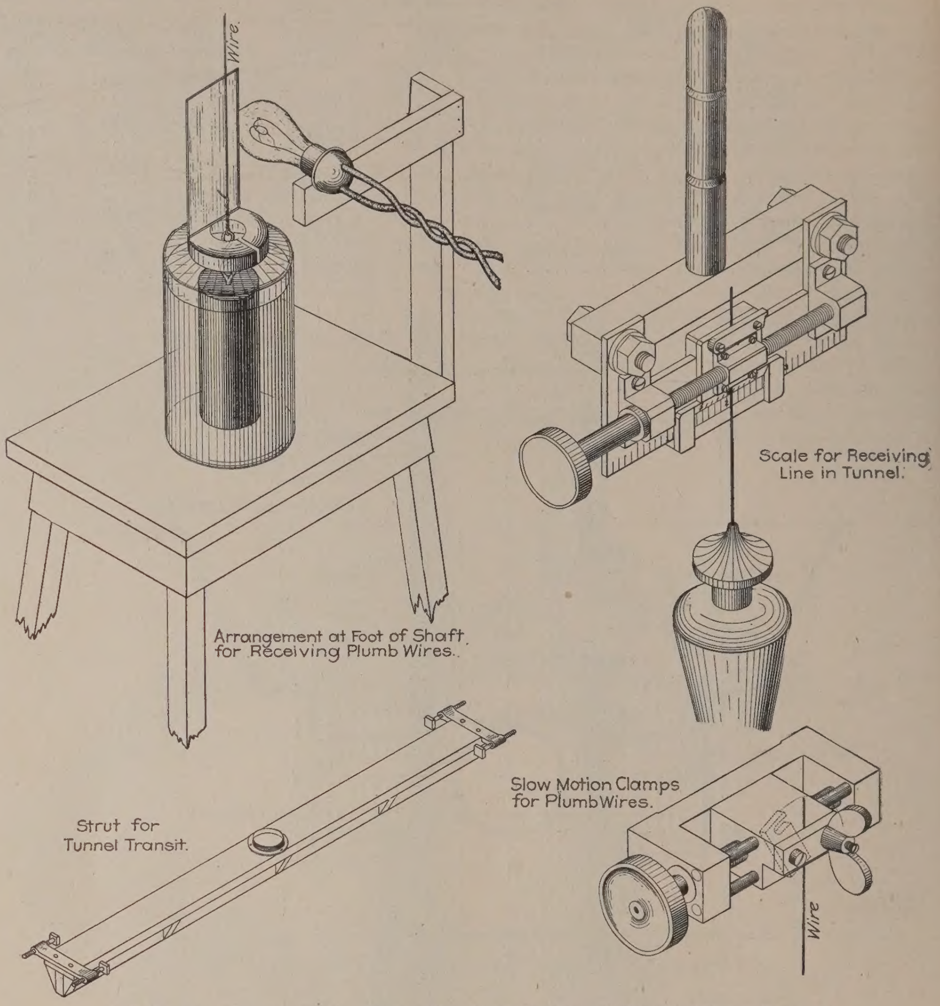
Working Shaft.—Each working shaft consisted of a riveted steel shell 12 ft. in diameter at the bottom, 10 ft. in diameter at top, lined with a 13-in. common brick wall, sunk by hand excavation to the water line. Below the water level the material penetrated, being sand and gravel, an orange-peel dredge was used. The weight of the steel shell and its lining was sufficient to sink it as the material was excavated. When the rock was reached an air lock was placed on the top of the shell, the water forced out and the excavation of the rock done under compressed air. The shell was sunk about 3 ft. into the rock, sealed and the rock excavation continued down to a point about 4 ft. below the bottom of the tunnel. This additional depth served as a sump for collecting water and for the suction ends of the pumps. A short section of tunnel, about 50 ft., was driven into each heading. A short section of the tunnel lining was then built and the rock excavation of the shafts lined with a 13-in. vitrified shale brick wall in Portland cement mortar, underpinning the shoe of the steel shell. The air pressure at the various shafts varied from 30 to 40 lb. above the normal.

After the tunnel lining was completed in the headings, the sumps were filled with concrete and the tunnel lining carried across the shafts. The arching was reinforced with four additional rings of brick, the shafts filled with Portland cement concrete to the rock surface and with earth above that point to the surface of the ground.

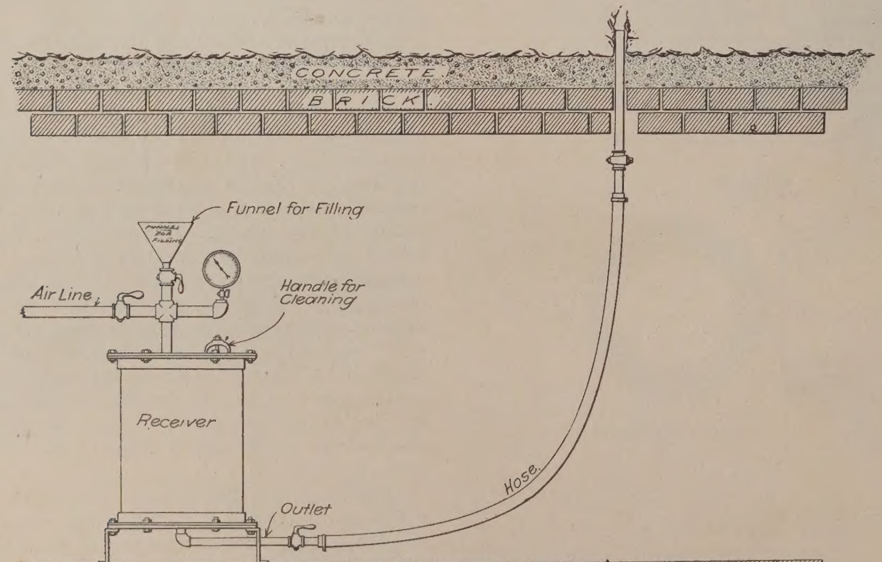
Permanent Shafts.—The permanent shafts above the rock consisted of cylindrical riveted steel shells, 12 ft. in internal diameter, ¾-in. plate, lined with a 12-in. vitrified shale brick wall, resting upon the cast-iron shoe of the shell. The brick used in the permanent shafts were 3x4x9-in., specially molded to a radius of 5 ft.

Shaft No. 1.—The surface of rock at this shaft, being within 35 ft. of the ground surface and well above the water line, the shell was assembled, riveted and sunk to the rock and afterward an open timbered pit was excavated around and the seal between the shell and the rock made from the outside. The excavation of the rock, from the shoe of the shell to the tunnel, was carried on in open air. While the excavation could be done without air pressure, there was far too great a leakage to prevent the lining being done without. An air lock was placed on the top of the shell and the lining completed under a pressure of 15 to 20 lb. above the normal. The lining of the shafts in rock excavation consisted of two rings, 9 in., of vitrified shale brick in Portland cement mortar, backed up with 6 in. of Portland cement concrete. Vertical grooved posts, supported by horizontal ribs and 8-in. block lagging, were used to support the lining. Each ring of lagging was backed with the brick and concrete before another ring was placed. In this manner the brickwork and the concrete backing were kept close to the top of the forms, permitting easy ramming of the concrete and keeping all the work within easy reach of the workingmen. The connection between the tunnel and shaft lining was made by a flaring invert and a saddle arch. Three photographs showing the construction of the saddle arch centers and lagging are reproduced in the accompanying illustrations. The completed form was taken in and set in place before placing the lock.

Shaft No. 5.—At this shaft, the depth of earth through which the steel shell had to be sunk was about 130 ft. With the straight cylindrical shell it was thought that the friction between the earth and shell would be greater than could be overcome by any weight which could be applied. The contractors resorted to the following method for sinking this shaft. An open cut with side slopes was made about 10 ft. in depth; a timbered pit 24 ft. square and 20 ft. in depth was excavated; inside this, a rivited steel shell, 17 ft. in diameter at the bottom, 16 ft. in diameter at the top and 40 ft. in length, lined with a 13-in. common brick wall, was built and sunk 40 ft. below the bottom of the timbered pit. Inside this a cribbing of railway ties was built, and upon it a section of the permanent shell about 60 ft. long was assembled, riveted and lined. The permanent shell was then lowered by removing the cribbing to the bottom of the outer shell, additional sections of the shell assembled and lined, guides put in at four points at top and bottom, and excavation begun inside the permanent shell. When the water line was reached, an orange peel dredge was used and the shell sunk by its own weight to the rock surface. At this elevation a lock was placed on the shaft, the water forced out, and about 6 ft. of rock excavation was done under compressed air and a seal made between the rock and the shoe of the shell. The pressure used was about 35 lb. By this method the shell was gently sunk to the required elevation. When in its final position the axis of the shaft was within 1½ in. of being truly vertical. The seal between the shell and the rock was so well made that no pressure was required to complete the rock excavation, nor to put in the concrete and brick lining. The connection between the tunnel lining was the same as described for Shaft No. 1.


Wire
Arrangement at Foot of Shaft for Receiving Plumb Wires.
Scale for Receiving Line in Tunnel.
Strut for Tunnel Transit.
Slow Motion Clamps for Plumb Wires.
Wire

Apparatus Employed in Surveying the Cincinnati Water-Works Tunnel.

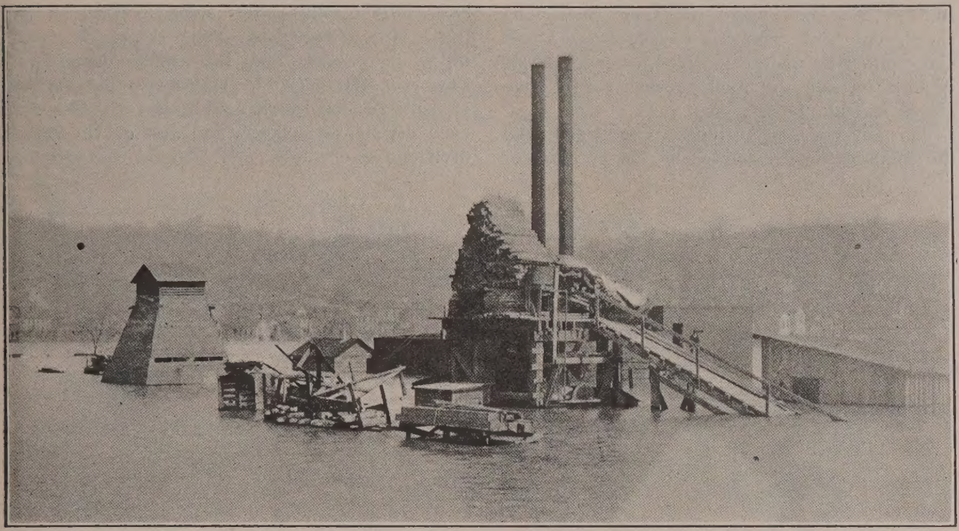


Machine Used for Grouting Leaks in Tunnel.

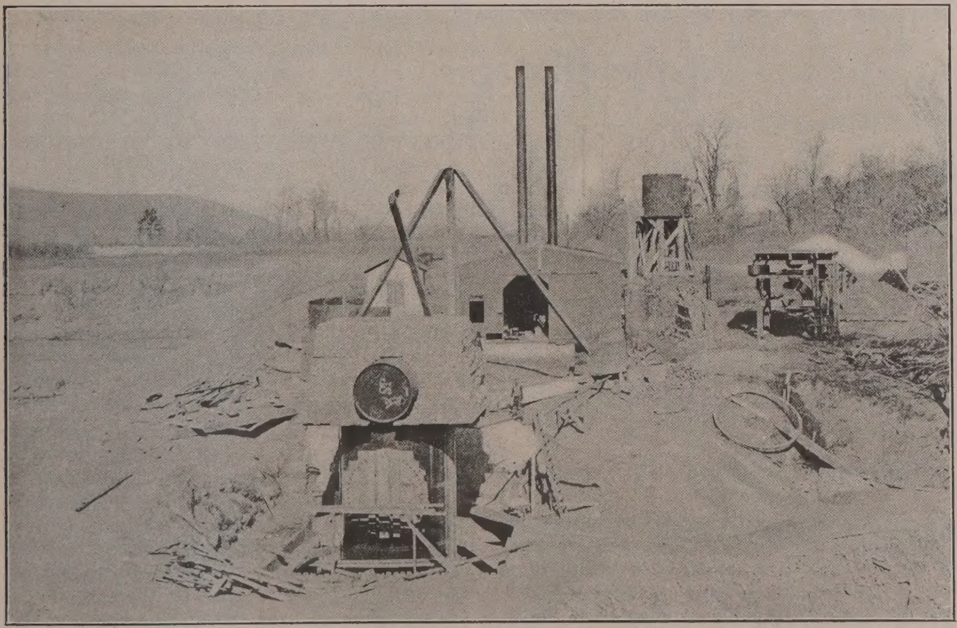
Tunnel Construction.—The rock was excavated to a minimum circle of 9½ ft. The lining consisted of two rings, 9 in., of vitrified shale brick, laid in Portland cement mortar, giving a completed interior diameter of 7 ft. All space between the rock and the extrados of the arch was filled with concrete composed of one part Portland cement, two parts clean river sand and four parts 1-in. unscreened, crushed limestone. The brick used for the tunnel lining were 4x9x3 in. thick on a medium line, and were specially molded for a 7-ft. circle. A section under the little Miami River, 1,000 ft. in length, contained ¾-in. round steel hoops around the brick lining spaced 2 ft. in centers.

After the connections with the shafts were made, the rock was generally found to be dry. The shaft locks were removed, guides for cages were built in the shafts and the tunnel excavation resumed. Sections of 400 to 800 ft. were excavated, trimmed, concrete and brick inverts constructed, the arch turned and packed, and then the same rotation repeated. The average advance per heading was 11 ft. of excavation per day, consisting of a day and night shift. Ninety ft. of concrete invert, about 60 ft. of brick invert or about 40 ft. of arching and concrete packing was the average advance per shift.

In the heading from Shaft 1 and the west or lower heading from Shaft 2, water was encountered in such quantities that compressed air at 40 lb. pressure was used when carrying the tunnel lining past these wet sections. These two sections, about 350 ft., and the connections and lining of the shafts, were the only portions of the work done under air pressure. However, these were not the only sections where a large inflow of water was encountered.


View of Shaft No. 2 during a Flood.

In other wet sections, when the trimming was completed the water was collected in pipes when it could be traced to a definite origin; in other cases it was collected in pans made of a shape conforming to the shape of the rock, and carried by pipes through the lining. In this way the masonary could be laid with a minimum amount of washing of the mortar. These pipes were allowed to run freely into the completed tunnel until all cement had taken a hard set.

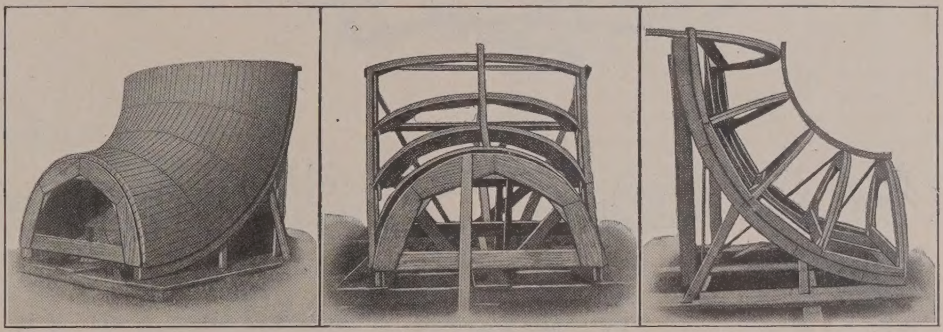

Air Lock on Shaft No. 5.

One section of about 1,000 ft. between Shafts 2 and 3 contained fully 300 pipes, 1 to 2 in. in diameter, all discharging water.

When in operation the pressure of water will be from the inside outward, and being the only conduit for the filtered water, the absence of leaks was a most essential requisite, and consequently the running pipes and leaks could not be allowed to remain. To fill the pipes a grouting machine, shown in one of the illustrations, was constructed, with which neat cement grout was injected into the pipes, using a pressure of 60 to 75 lb., until no more could be forced in. This grout traveled over and around the arch and into the fissures of the rock and practically stopped all leaks in the brickwork. Some of the largest leaks were not stopped when filling the pipes; in such cases a block containing a pipe was secured against the leak, the grouting machine attached and the leak filled with cement. All running leaks were stopped in this manner.

Test of the Inflow Leakage.—When the tunnel was completed a dam about 2½ ft. in height was built across the invert near Shaft 1. A short section of pipe was imbedded in the dam about 6 in. from the top. Water was allowed to collect and raise behind this dam and run freely through the pipe for some time before measuring the flow. Several trials showed a maximum leakage for the entire tunnel to be 10 gal. per min., nearly 15,000 gal. per 24 hours. When this is compared with the daily capacity of the tunnel, namely, 100,000,000 gal., the leakage is a small percentage. Subsequently when the tunnel is filled to its maximum head, tests for the outflow leakage will be made.

The plant used by the contractors at each shaft was as follows: Two 40 to 60-h.p. boilers, air compressor, dynamos and engine, hoisting engine, concrete mixer, cement storage shed, headhouse, cage, two tunnel pumps, track into tunnel, dump cars, two air drills on columns for each heading, small air drill for trimming, air and water pipes and electric light lines.


The Center Used for the Saddle Arch.

The tunnel construction was begun in July, 1900, and completed in April, 1904.

The work was done for the Board of Trustees, "Commissioners of Water Works," the late G. Bouscaren being chief engineer and the writer resident engineer. The W. J. Gawne Co. were the contractors for the entire tunnel.

An Intercooler of interesting construction, for a compressor built by Messrs. Angus Murray & Sons, Glasgow, was illustrated recently in "Engineering." It consists of one casting having a series of compartments arranged one above the other, for air and water alternately. The cooling water enters at the bottom compartment, and at one corner passes upward to the next water compartment, which is above the air space immediately over the first water compartment, and so on till it leaves the cooler. From this point the water is used in the covers and jackets of the low-pressure cylinder and then in the covers and jackets of the high-pressure cylinder. The air travels downward through the intercooler opposite to the flow of the water. The compartments for both air and water are provided with baffles to ensure a circulation through each compartment. A feature of the intercooler on which emphasis is laid is that there are no internal joints or pipes to cause trouble, and yet a large surface is exposed to the cooling action of the water. It is rectangular in plan.

THE CUMBERLAND EXTENSION OF THE WESTERN MARYLAND R. R.—I.

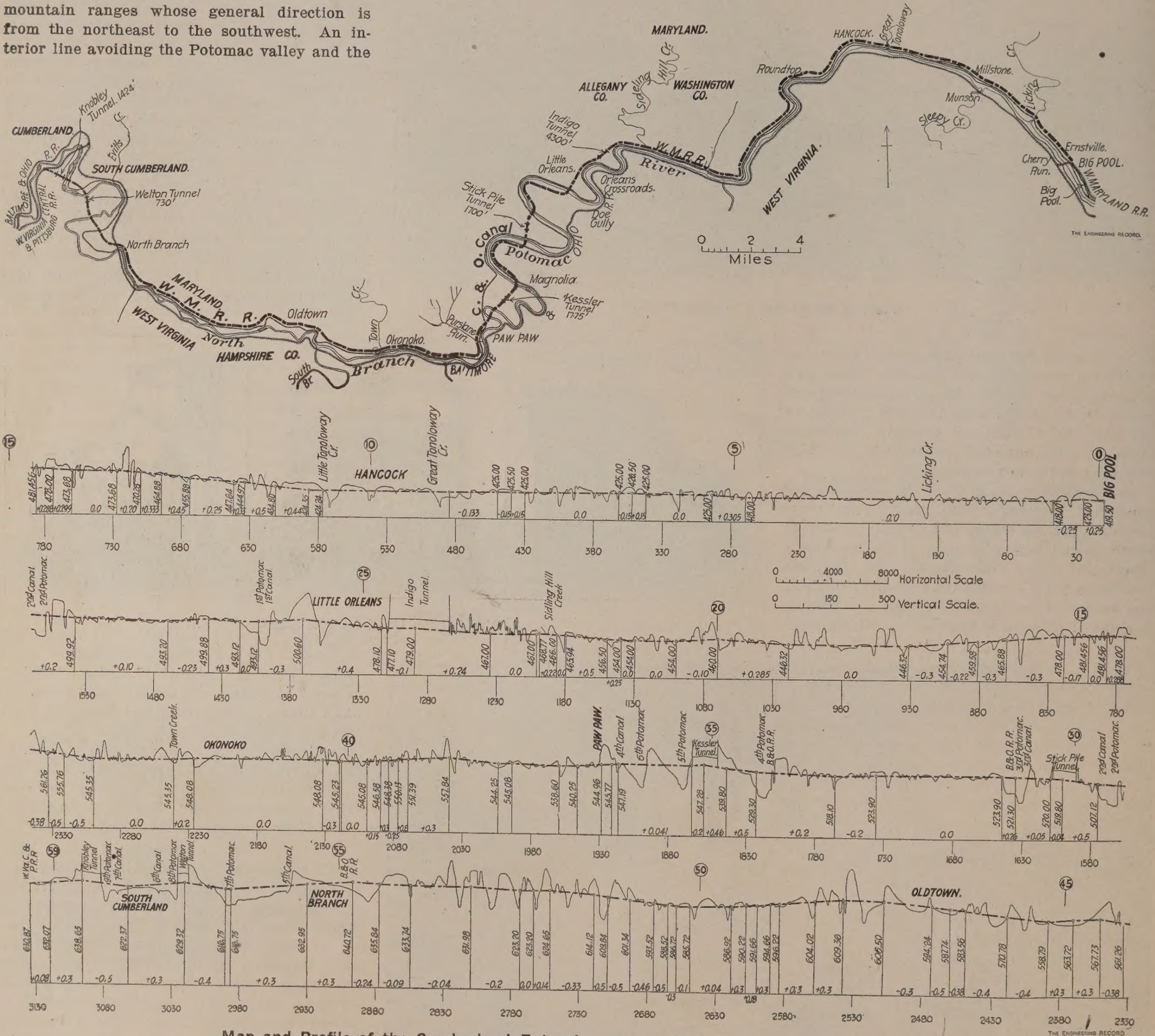
Construction of the New Link in the Eastern Part of the Gould System.

In the seaward progress of the Gould railway system from Pittsburg, the key to the situation may be considered the 60-mile extension of the Western Maryland R. R. from Big Pool to Cumberland, occupying the narrow and tortuous valley of the Potomac River. The Baltimore & Ohio R. R. is built along one side of the valley, while the Chesapeake & Ohio Canal occupies the opposite side. The river along the route of the extension cuts through a series of mountain ranges whose general direction is from the northeast to the southwest. An interior line avoiding the Potomac valley and the routes of other corporations would necessarily contain such grades as to prohibit the economical handling of heavy coal and through traffic. To avoid such a handicap, and to locate the line in such a manner as to make it physically equal or superior to its competitors, only the Potomac River valley line could be considered.

The construction of a new and independent line along the river route has been held for many years to be next to impossible, owing to the topographical conditions and the occupation of one side of the valley by a railroad already constructed and the other by a canal. After several alternative preliminary and location surveys had been made and their lines compared, both with reference to construction cost and economical operating value, a location was decided on and the final surveys for it completed in May, 1903.

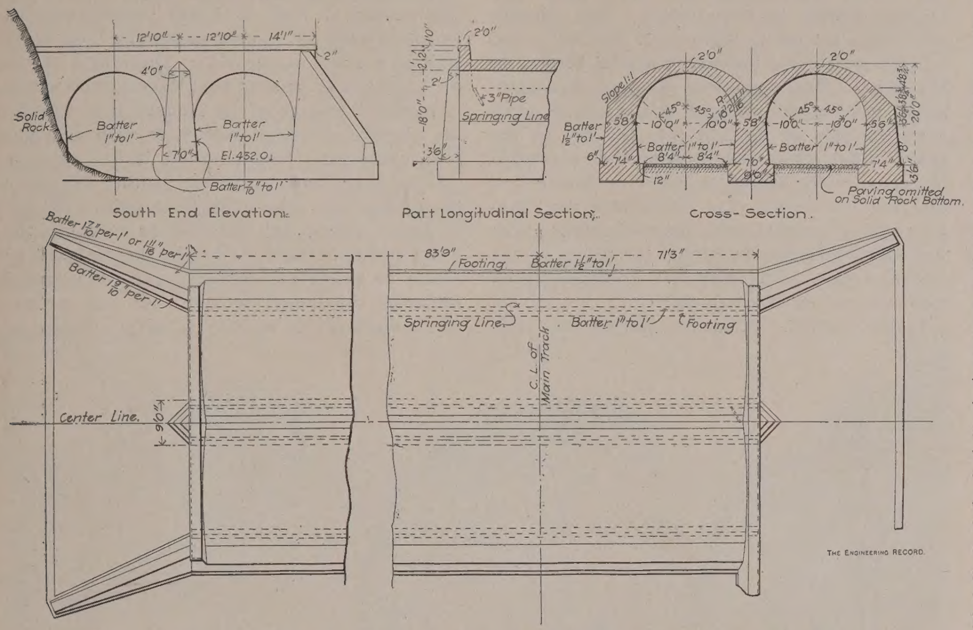
The adverse topographical conditions and the complications presented by the presence of the canal and the railroad have required five tunnels of considerable length, nine crossings of the Potomac River, seven of the canal, three of the railroad and several other large works. By the use of this unusual amount of tunnel and bridge work, however, there has resulted a material shortening of the line as compared with the Baltimore & Ohio R. R., which it parallels most of the way. It is 8 miles shorter than the line of that road between opposite points at each end of the Cumberland extension, has a maximum curvature of 6 deg. as compared to 9½ deg. on the older line, and a maximum eastbound grade of 16 ft. to the mile as compared with a maximum of 30 ft. on the Baltimore & Ohio.

The line is divided into three divisions for construction purposes. The first, extending from Big Pool to Sideling Hill Creek is 22.2 miles long; the second, from Sideling Hill Creek to Paw Paw, is 14.2 miles in length, and the third, from Paw Paw to Cumberland, embraces 22.8 miles of construction work. Bids were asked for each division separately and also on the three divisions as a whole. The general contract for constructing the first division was awarded on August 1, 1903, to the Degnon Contracting Co., of New York. The MacArthur Brothers Co., of Chicago, and the Kilpatrick Brothers & Collins Contracting Co., of Omaha, were jointly awarded the general contract for the work on the second and third divisions. These two divisions comprise about 80 per cent. of the work, including all the tunnels and Potomac River crossings. The Pennsylvania Steel Co., of Steelton, Pa., was awarded the contract for furnishing and erecting all the steel work.



Map and Profile of the Cumberland Extension of the Western Maryland Railroad.

The construction work is being prosecuted with an average force of 2,500 men, together with large plants of machinery, and is approximately two-thirds completed. Track is laid on the lower 11 miles of the first division and trains will soon be operating over it. The work on the remainder of this division is being carried on as rapidly as circumstances will permit. Some of the sections on the other divisions are ready for the track, but several of the bridges are yet to be erected and much of the tunnel work remains to be completed, as well as a portion of the grading.



Plan and Elevations of Twin Twenty-Foot Concrete Arches near Little Orleans, Md.

The extension is to be a single track road, but many of the structures are so built and much of the construction is being so executed as to facilitate double-tracking the line. The bridge piers and abutments have all been built to carry two single-track bridges. Those that are being erected are single track structures and are placed on the right of the foundations. The tunnels are of greater cross-section than is usually provided for a single track and this cross-section is such that it may readily be increased to provide room for two tracks. The grading has been done with future double tracking in view, and provisions have been made, where possible, for the disposal of the material that will be obtained in widening the cuts, while the embankments in places have been widened or provision made for future widening. The culverts and arches which have been built to provide waterways are of sufficient length to permit the building of a double track embankment on them.

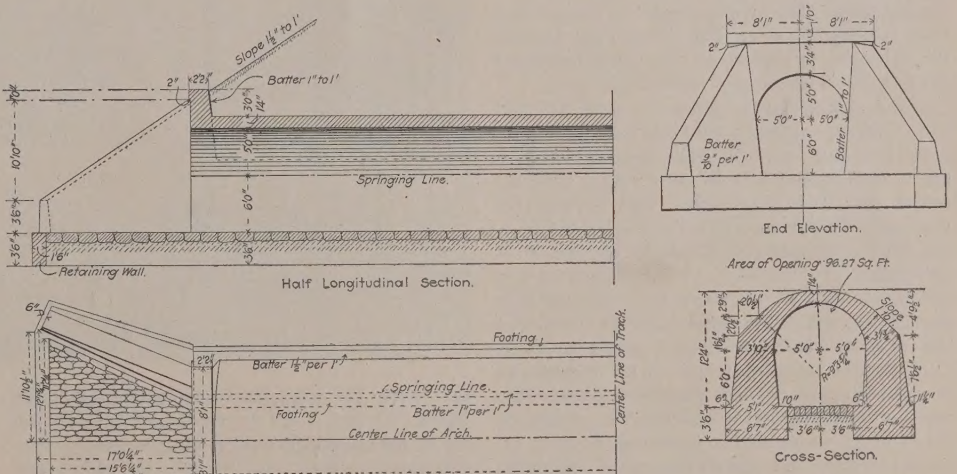
Division 1.—The present terminus of the Western Maryland R. R. is at Cherry Run on the West Virginia side of the Potomac River, the line crossing the river and the canal on a bridge and a long trestle at that point. The extension proper begins at Big Pool on the Maryland side of the river directly across from Cherry Run and throughout the first division, extending to Sideling Hill Creek, a distance of 22.2 miles, the track very closely parallels the river and the canal. It is in no place farther than 900 ft. from the bank of the river, the canal lying between them.

The construction of this part of the road is not difficult when compared with the work on the upper divisions. Still it requires some unusually heavy and expensive work, but the result will be a road with remarkably low grades and a small percentage of curvature. On the lower end of the division the line for considerable distance was located on the old National Turnpike requiring its complete relocation and reconstruction for 3 miles and many changes in it at other places. Whenever these alterations were made the new road has been ballasted for a width of 30 ft. with 4 in. of broken stone, the grades have been kept below 8 per cent., and iron bridges have been provided where needed. The railroad company is also required to maintain such work as was done on the road for a period of two years. Thirty-four wires belonging to different telegraph companies are carried on three sets of poles along this road, and they also had to be relocated.

The first 10 miles of the line, with the exception of about 500 ft. of 0.30 per cent. grade, is practically level. The grading as far as Licking Creek, 3 miles from the lower end, is earth and loose rock work of ordinary character. The crossing of Licking Creek is made on a deck-girder bridge with three 80-ft. spans having concrete piers and abutments. Beyond this bridge, in sections four and five, some heavy work was encountered. East of Millstone a fill requiring 27,000 cu. yd. in a length of 600 ft. is the only single piece of heavy earthwork on sections six, seven and eight, although large quantities of material were required to be moved in them. The fill on section nine, which carries the line across Tonolway bottom, is the heaviest work on the lower part of the division, as it contains about 55,000 cu. yd. The crossing of the Great Tonolway Creek near the west end of this fill, is made on a skew deck-girder bridge with three 80-ft. spans placed on concrete piers and abutments. The track is laid to a point just beyond this bridge, a short distance below the town of Hancock and a temporary station is being laid out there.

Side-Hill Difficulties.—The grading in the lower part of Hancock has been deferred until decision is made on the method of crossing a canal basin located at that point. Above this for some distance, however, the roadbed is being rapidly brought to grade. Just west of Hancock a 25-ft. concrete arch at the bottom of a fill containing 37,000 cu. yd. provides a waterway for the Little Tonolway Creek. From here the beginning of a gradual ascent to a summit at one side of Little Round Top Mountain is marked by a cut in loose rock containing 35,000 cu. yd. of material. The work for about the next two miles is heavy rock excavation, approximating 50,000 cu. yd. per mile, while just beyond it, section thirteen, containing 12,000 cu. yd., is the lightest one on the whole extension. A cut 700 ft. long which contained 27,000 cu. yd. of solid rock is then encountered, leaving which the track for some distance lies about 50 ft. above the water in the canal and from 75 to 300 ft. from it, on the side of the mountain. The line was located in this manner in order to be able to stay on the higher ground about a mile further up and thus avoid, to a considerable extent, closely paralleling the canal. The track is to be carried along the abrupt face of the mountain on a bench built into the solid rock. The preparation of the roadbed at this point in less than a mile will require the excavation of 65,000 cu. yd. of solid rock from the side hill and a large amount of retaining walls.

In order to reduce the ascending eastbound grade to 0.3 per cent,, a cut containing 40,000 cu. yd. had to be made a short distance beyond the side-hill location, the material from the cut being used in making a fill 60 ft. in height. Approximately 55,000 cu. yd. per mile were re-



Standard Ten-Foot Concrete Arch, Western Maryland R. R.

Quantities.

For each Culvert	C. Y.
2 End Pavings	17.40
4 Wing Foundations	44.16
2 Retaining Walls	8.97
2 Parapet Walls	12.38
4 Wing Walls	70.44
Per Lineal Ft. of Arch	C Y
Paving	0.259
Foundations	1.707
Arch and Side Walls	3.587

THE ENGINEERING RECORD.

quired to be moved in the next 2½ miles. The line then approaches and parallels the canal quite closely and the first serious complications from this standpoint are met in sections nineteen and twenty. For considerable lengths in these sections the track will have to be carried on a shelf cut in the abrupt solid rock berme side of the canal at a height of from 12 to 20 ft. above the water in it.

A county road built along the berme side of the canal upon the site chosen for the track had to be relocated at various points along this part of the work. There were practically three miles of this relocation required and as the rock hillsides rise very abruptly from the water's edge, the construction of a wagon road on the cliffs above the railroad has required much heavy rock excavation. Retaining walls have been built to hold it in place at different points and in some instances it lies more than 100 ft. above the track, the slopes being so steep as to require the placing of the road at this height in order to obtain sufficient width to construct it without extending over the tracks below.

With the exception of the crossing of a canal basin about 600 ft. in width on a trestle, and a fill just west of this basin containing 40,000 cu. yd., the remainder of the work on the division is comparatively light and presented no serious obstacles.

In prosecuting the work on the lower division very little machinery has been employed, the greater part of the loose and solid rock excavation having been made by hand after blasting, the materials being moved in narrow gauge dump cars drawn by mules. A 65-ton Vulcan steam shovel was used to some extent on the lower end of the division and a Marion steam shovel with a 1½-yd. bucket is at present at work a short distance above Hancock. A considerable force using wheel scrapers has been at work for some time at the upper end of the division, but most of the work has been done by the method just described.

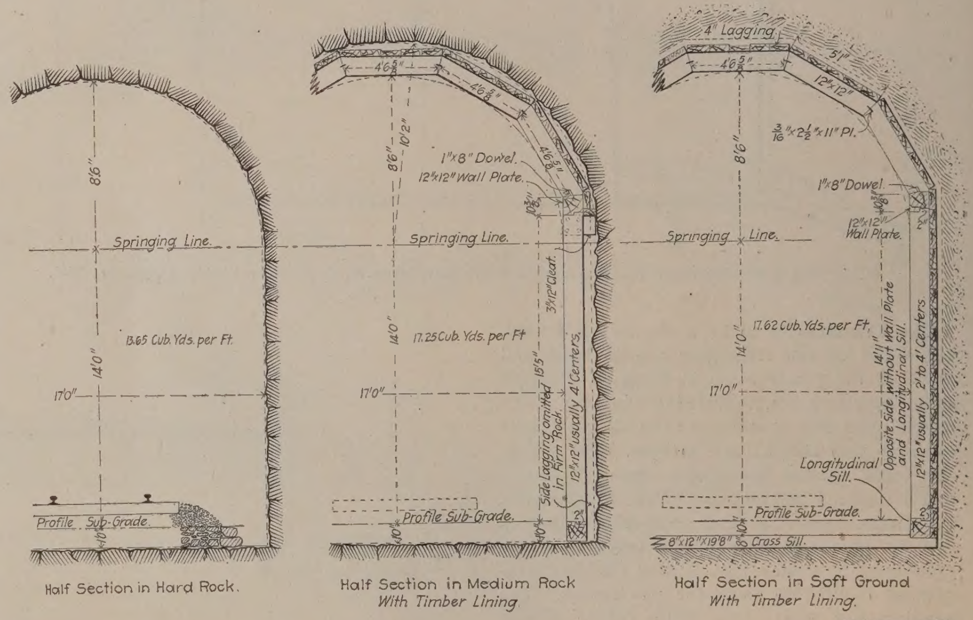
Division 2.—The crossing of Sideling Hill Creek, which separates the lower and middle divisions, is made on a deck-girder bridge consisting of a 95-ft. and a 50-ft. span with a concrete center pier and abutments. The foundations were not difficult except in the case of the pier, for which the excavation had to be done in a cofferdam to a depth of 14 ft. The bridge is parallel to and within a few feet of a masonry aqueduct carrying the canal over the creek, and the material which has filled in above the aqueduct since it was built had to be removed at the pier site. A wooden scow in a remarkable state of preservation was found at a depth of about 10 ft., which had to be almost entirely removed before the cofferdam could be made water-tight and the concrete put in place. A 1½-yd. Ransome concrete mixer was installed on the east bank directly above the site of the east abutment and the concrete was delivered from it into this abutment through a chute. A temporary pole trestle, built across the creek, was used in transporting concrete to the pier and the other abutment.

Heavy Blasting.—Leaving this bridge the track is to be carried on a fill for a short distance, while beyond that for nearly 2 miles some of the most difficult construction on the entire line is encountered. The canal along this portion of the road was built by making an embankment on the edge of the river, and then cutting a channel between this embankment and the hillside through the solid rock, which rises to considerable heights on slopes of 1 to 1, or steeper, directly from the river's edge. The line closely parallels the canal on its berme side at varying distances above it on these rock ledges. The track is to be carried on a shelf cut in them, and will have to be supported in places on fills held in place by masonry retaining walls.

A number of horizontal drift holes large enough for men to work in were excavated in the face of these ledges at right angles to the line. These holes were placed with their bottoms about level with the finished grade and carried in to the inside edge of the site of the shelf. Drifts parallel to the line were extended both ways from them for considerable distances and the whole system of coyote holes, as they are called, was drilled with blast holes and charges placed in these holes. The charges were then set off in sections of the work and a large part of the loosened material thrown in the canal. The remaining material was excavated with steam shovels and dumped down over the side of the hill into the bed of the canal. Four steam shovels were then placed in the canal, after the water had been drawn out, and the spoil which had fallen into the channel was excavated and dumped beyond the tow-path embankment along the edge of the river. A total of 140,000 cu. yd. of solid rock was removed in this manner.

Indigo Tunnel.—From the end of this side-hill work the track is to be carried through Indigo Tunnel, 4,333 ft. from portal to portal, the first and longest tunnel on the line. A narrow gulch cutting into the hill on whose side the track is to be laid, at this point separated it from the hill through which the tunnel is being driven. As the tunnel portal is directly over the gulch, close to the canal, and the hills rise abruptly above it on all sides, some special method of disposing of the material obtained in the excavation of the tunnel had to be devised. The space in front of the portal was filled to grade, then a narrow-gauge, double-track tramway was laid up one side of the gulch on a grade of about 20 ft. in 100 ft. A 10x18-in. Lidgerwood hoisting engine with a 52-in. drum, operating a 1-in. wire cable, together with an 80-h.p. Lidgerwood hoisting engine, were erected on a somewhat level site about 500 ft. up on the hill. Loaded dump cars are switched from the track in the tunnel to the tracks of the tramway, and then elevated by the hoisting engine to a point just below the engine house, where the tracks diverge, one going to each side of it onto a dump where the material is dumped. Two loaded 3-yd. cars are elevated together. A hoisting engineer, a switch boy at the lower end of the incline, who also handles the cars in the tunnel, and two men on the dump are able to dispose of the material as rapidly as it is excavated and to keep the dump in condition.

A somewhat unusual method is being employed in driving this tunnel. A bottom heading 9 ft. in height and of the width of the tunnel is being removed first. Drill holes are then to be cut in the rock above this heading and a portion of the remainder of the section blasted. The loosened material falls on the floor and a Marion shovel with a 1½-yd. bucket operated by compressed air, is used in placing it in dump cars on a track at one side. The length of the drill holes is to be such that the material which is loosened will be of an amount that will fill the already excavated section to such a height that drills may be placed on it and used in making blast holes to remove another lift above the second one. The holes in this third lift are to be so placed and directed as to cause the blast placed in them to loosen the material as nearly as possible to conform with the required shape of the tunnel section. As this method was considered to embody a certain degree of uncertainty as to its feasibility, a short length of the cross-section of the finished tunnel was driven at the west end in order to test it before much progress had been made on the lower heading. Practically no difficulty was experienced in doing this work, the breaking out of the blasted material usually conforming as closely to the required section as it does in similar material removed by other methods.



Half Section in Hard Rock.

Half Section in Medium Rock With Timber Lining.

Half Section in Soft Ground With Timber Lining.

The Engineering Record.

Standard Tunnel Cross-Sections, Western Maryland Railroad.

The first drift has now progressed 2,000 ft. from the east portal and 1,800 ft. from the west one. The drilling and blasting are all done at night and the loosened material removed during the day. A cut 6 ft. wide is first made at one side by placing a blast in six to eight 12-ft. holes. After this has been set off a charge is placed in sixteen to eighteen 10-ft. holes over the remainder of the face, which loosens the balance of the heading to a depth of 7 to 10 ft. From 175 to 200 lb. of dynamite are required in making this amount of progress. The material met with thus far in the work is a hard shale which is easily blasted, but holds its place sufficiently to need no timbering as the work proceeds.

Ingersoll-Sergeant drills, operated by compressed air at a pressure of from 80 to 100 lb. per square inch, are used in this tunnel. A plant containing two 24x30-in. Ingersoll-Sergeant air compressors is located near the west portal which supplies air to operate the drills, and will also supply air to operate the shovels when they are installed. A 6-in. pipe line 7,100 ft. in length, laid over the top of the hill conveys air to the east end. A Wagner electric generator furnishes current for lighting the tunnel at all times and the outside work at night. Ventilation is obtained by means of a No. 8 Sturtevant exhauster near each portal, connected to a line of 14-in. spirally-riveted steel pipe laid in the tunnel to the point where work is in progress. Steam for the plant is furnished by four 100-h.p. Brownell boilers.

The disposition of the material from the tunnel was also a serious problem at the west end, owing to surroundings there similar to those at the east end. An inclined tramway of the same type as the one at that end is installed here and material is disposed on a side hill gulch in the same manner. The tunnel is being driven by the general contractors.

Twin Twenty-Foot Concrete Arches near Little Orleans, Md.

The line leaves the tunnel on a short 6 deg. curve which carries it to another stretch of side-hill work paralleling the canal. The work along this section is not of such serious nature as that encountered farther down, owing to the line lying farther away from the canal and to the side hill being neither so steep nor so rocky as that mentioned before. No work, however, has as yet been done here on a section about one mile long but will be undertaken while the water is out of the canal.

A Heavy Cut.—Beyond this work the line passes over a fill about 700 ft. long and from 20 to 70 ft. in height. The material for making this is obtained from a cut just beyond it which is one of the heaviest on the line. It is 2,200 ft. long and 70 ft. deep at the center. The original estimate of the material to be removed was 107,000 cu. yd., but, owing to the encountering of a peculiar formation near the center of the cut, about 150,000 cu. yd. will have to be removed before its sides can be made to hold their places. The formation is a somewhat disintegrated rock in thin vertical strata covered with from 6 to 20 ft. of clay and loose rock. The strata lie parallel to the line so when a blast is set off to loosen material or excavation made from below, they are forced into the cut by their own weight and that of the overlying clay and loose rock. The cut is already from 80 to 120 ft. wide at the top and in places will probably have to be made still wider. A Marion steam shovel with a 1½-yd. bucket has been at work here for more than a year.

A pair of 20-ft. concrete barrel arches, 155 ft. long, are built beneath the fill just below this cut. They have one wall in common and are founded on rock which lies at the surface. There are two wing walls on the upstream side and one on the lower, the rock ledge against which they are placed forming a natural wing wall in place of the other one. About 3,200 cu. yd. of concrete was required in their construction.

(To be continued.)

Comparative Boiler Tests at the farm-implement manufacturing works of the Dempster Mill Manufacturing Co., at Beatrice, Neb., with and without the Jones stoker, are reported in the "Publicity Magazine," issued by the Underfeed Stoker Co. of America. In the handing firing test one 80-h.-p. and two 75-h.-p. return tubular boilers were used, and in 10 hours 7,620 lb. of Kansas nut coal of 9,852 B.t.u. calorific value, costing $3.60 per ton and giving 24.3 per cent. of refuse, were burned. An actual evaporation of 5.32 lb. per pound of coal was obtained, or an equivalent evaporation, from and at 212°, of 6.49 lb. In the stoker test one 80-h.-p. and one 75-h.-p. boiler were used, and in 9 hours 5,500 lb. of Missouri slack coal of 8,618 B.t.u. calorific value, costing $2.04 per ton and giving 29 per cent. of refuse, were burned. An actual evaporation of 6.05 lb. per pound of coal was obtained, or an equivalent evaporation of 7.37 lb. In both tests the feed water was at 40° temperature and the steam pressure slightly over 100 lb. The saving in the cost of fuel for the same amount of evaporation in the two cases is figured out at 50.1 per cent. as a result of the use of the stokers. In the latter case the boilers were operated nearer their rating.

The Erection of the Blackwell's Island Bridge—I.

The bridge to be built across East River at New York, from East 59th St., Manhattan, over Blackwell's Island to Ravenswood, in the Borough of Queens, will have five cantilever and anchor spans aggregating 3,724 ft. between anchorages, and including a channel span of 1,182 ft. Its cost, inclusive of approaches and $3,000,000 for land, is estimated at about $12,500,000, and it will contain about 54,000 cu. yd. of masonry and over 86,000,000 lb. of steel in the five main spans. The foundations were carried to rock in open pits, and their construction, and that of the main piers and the general design, has been described in The Engineering Record of March 16, 1901; Dec. 13, 1902; Feb. 28 and Aug. 22, 1903, and March 3, 1904. Preliminary surveys were completed in June, 1899; the contract for the substructure was awarded to Ryan & Parker on June 27, 1901. Work on it was commenced July 19, 1901, and was completed June 10, 1904. The contract for the superstructure was awarded to the Pennsylvania Steel Co. as the lowest bidder in November, 1903.

The main spans are remarkable for their dimensions; for the omission of the center connecting spans usually suspended from the ends of the cantilever arms; for the peculiar design of the main vertical posts, and for the use of eyebars of extremely large proportions made with nickel-steel of an ultimate strength of 85,000 to 100,000 lb. per sq. in.

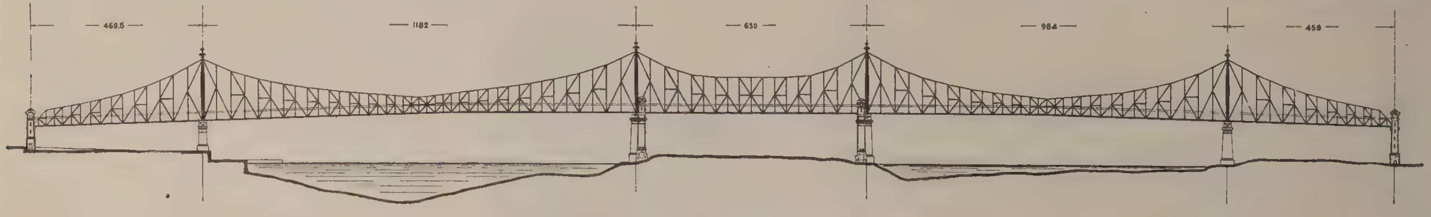
The superstructure has pin-connected trusses in vertical planes 60 ft. apart on centers, 185 ft. deep center to center of pins at the piers, and 135 ft. high in the clear above mean high water. It is 90 ft. wide over all and will carry two elevated railroad and four electric car tracks, two carriageways and two sidewalks, with an estimated capacity of 150,000,000 passengers a year in the elevated and surface cars.

Comparisons.—The main span of this bridge will be much longer than any independent truss span so far completed on this continent, and longer than any such in the world except the two 1,710-ft. spans of the double-track Forth Bridge, Scotland. The Brooklyn Bridge and the Williamsburg Bridge, New York, cross the same river within a few thousand feet of its site, and have spans of 1,595 ft. and 1,600 ft. respectively, but are of the suspension type with stiffening trusses. The Quebec bridge now being constructed across the St. Lawrence River will have an 1,800 ft. channel span, but will not have as large a capacity, nor will its members have as great maximum cross-sectional areas.

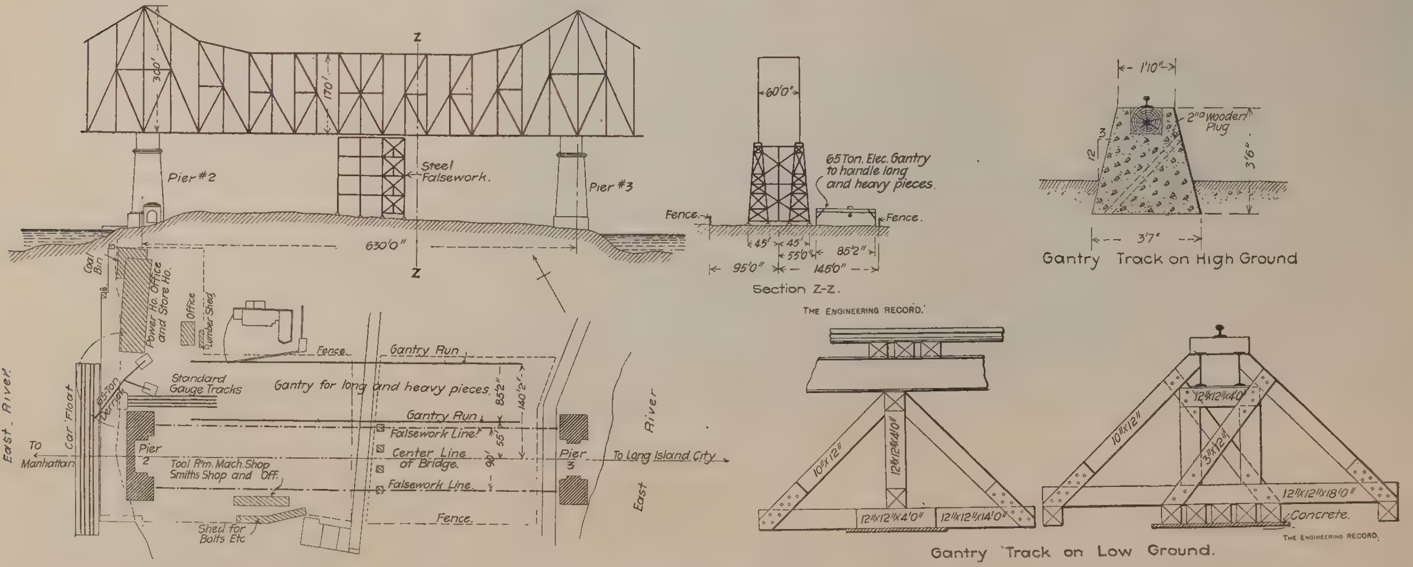
Neither the design nor the erection of this bridge is comparable with the Forth bridge, because the latter has inclined trusses with riveted connections, and the different main members, unlike those of the Blackwell's Island bridge, are made with tubular sections and were built up in place, large shops having been established at the site for the purpose and nearly all work and plant being special. In this bridge the members will be wholly completed at the shops with the ordinary plant. They will be erected, whole, and quickly connected to be self-supporting, by plant corresponding to that ordinarily used by the contractors for heavy bridge work, modified and developed as required for the increased dimensions and decreased clearances of this work.

The two bridges most nearly comparable with this for design and erection methods are the Quebec Bridge, which is illustrated and described in this issue, and the Wabash R. R. double-track bridge across the Monongahela River at Pittsburg, which is also a pin-connected cantilever 1,504 ft. long between anchorages, including an 812-ft. center span. This latter bridge weighs about 14,000,000 lb. and cost about $800,000, and its design and erection were described in The Engineering Record of Jan. 3, 1903; March 5, April 2 and April 9, 1904. The trusses are 32 ft. apart on centers and have a maximum depth of 126 ft. The main span weighs about 7,000,000 lb. and was erected by an average force of 100 men in 90 working days. It was erected at a clear height of about 70 ft. above the water without obstructing navigation, by a pair of 288-ton Z-shape steel tower travelers 109 ft. high, resembling those designed for use on the Blackwell's Island Bridge. The erection was simplified and final connections were facilitated by the center suspended span joining the cantilever arms, and the heaviest pieces in the trusses weighed less than 30 tons.

Erection Methods.—It is thus evidenced that no previous work furnished a precedent for the methods of construction and erection necessary to adopt for the Blackwell's Island Bridge. Some of its members weigh over 120 tons each and are 50 ft. to 100 ft. long; some of them have to be assembled at a height of more than 300 ft. above the water, and a large proportion of the structure must be erected high over 1,000-ft. channels with deep water, swift current, constant navigation by steamers, barges, ferrys and sailing vessels where it is impossible to sustain the superstructure of the longest spans on falsework, and the operations must be carried on continuously during the severe winter weather and high winds to which the site is exposed. It is expected to erect 86,000,000 lb. of steel in 20 consecutive months.



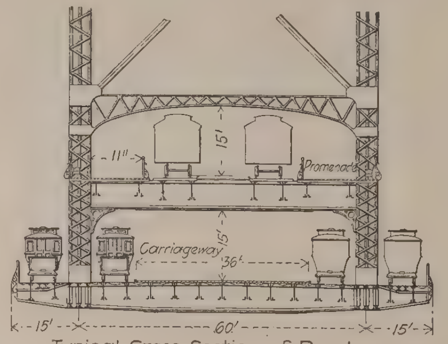
General Elevation of Blackwell's Island Bridge.



General Features of Erection Plant on Blackwell's Island.

Under these conditions the method and plant of erection were of the first importance, and from the outset great care was taken to design the superstructure in accordance with the interests of the most accurate, safe and expeditious erection. The somewhat unusual and very excellent condition obtained of holding frequent conferences between the corps of designers of the Department of Bridges of the city, who determined the general features and character of the details and connections, and the contractors' engineers of construction and erection, who were familiar with the requirements of shop practice and the most efficient service of the machine tools, and planned the most efficient provision for erection operations.

The general plan of erection embraces some unusual features, and has been carefully perpected in advance of the commencement of field operations, all essential elements have been determined and the details worked out in the order in which they will be required for use. The problem has been treated rationally both as a commercial and mechanical proposition, and while experiments have been avoided the most advanced methods and improved appliances have been adopted and modified, and great liberality has been exercised in providing for the excellence of the work. The permanent and temporary structures have been analyzed at all stages of construction and under all combinations of conditions likely to arise, and precise mathematical calculations have been made, strain sheets computed and designs checked with as much care for the erection plant as for permanent structures. The building of the erection plant has been done at the contractors' shops under regular orders subject to the same supervision and inspection as commercial orders, and the materials have been of the best quality that could be rolled or purchased.



Typical Cross-Section of Roadways.

The 630-ft. island span, 185 ft. deep center to center of pins at the towers, and the 469.5 and 459 ft. anchor arm shore spans will be successively erected on falsework, after which one-half of each channel span will be simultaneously built by the cantilever method from the island to mid-stream, then the travelers will be removed, carried to the shores, re-erected on the anchor arm spans, and the shore ends of the main spans erected by the cantilever method, completing the work at the centers of the main spans.

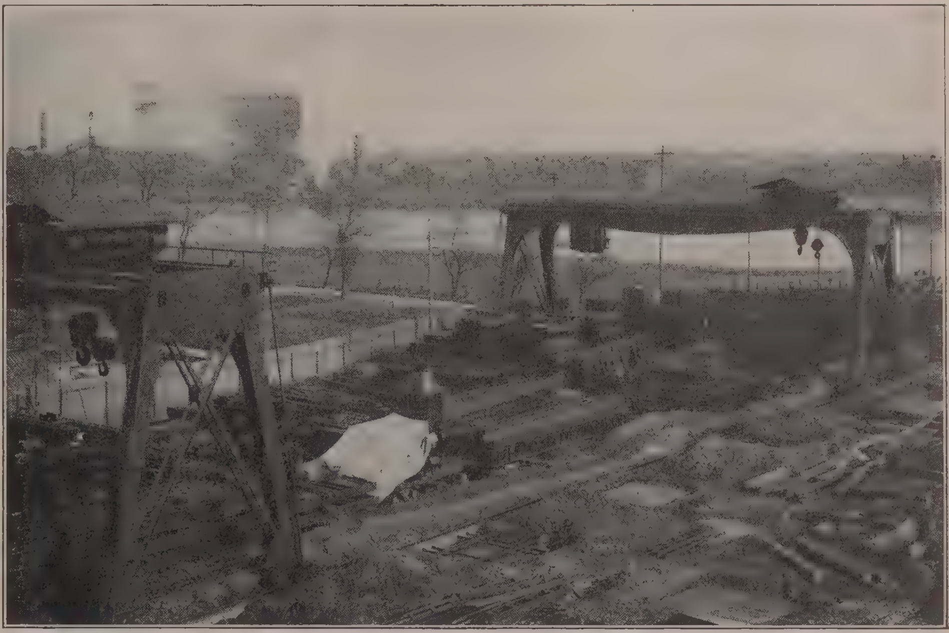
Island Plant.—An erection plant costing several hundred thousand dollars is being installed. An office for the resident engineer and superintendent has been established at the foot of East 59th St., near the west end of the bridge, with city and long distance telephone communication, including a private line to the shops near Harrisburg, Pa., and to the foremen's offices on the island and on both sides of the river. Three separate power plants, storage yards, shops and docks will be established, one on each side of the river and the third on the island. Materials will be stored and handled by large electric gantry yard cranes of 65 to 80 tons capacity. Steel falsework will be provided for the erection of the anchor and island spans. Two types of powerful steel travelers will be used for the erection of the island or connecting span in successive operations. Large hoisting engines with novel improvements have been built especially for use on these travelers. Special steel derricks with a capacity of 65 tons and booms 75 and 85 ft. long have been built by the Pennsylvania Steel Co. for unloading and handling the truss members. Special 500-ton jacks have been designed for swinging the trusses, and much special rigging and many special hydraulic and pneumatic tools have been designed for use on the great truss members, which have been designed with dimensions of the full limits imposed by present standards of manufacture and transportation.

A strip of land about 240 ft. wide and 700 ft. long, extending across the island on the line of the bridge, has been allotted to the contractor for his shops, power plant, storage and for the erection of the connecting span and service of the island arms of the channel cantilevers. It is enclosed by a high close board fence, through which near the center of the span and transverse to its axis a 20-ft. passage has been left for the prisoners employed in public work on the island. At the east end the water front cannot be utilized on account of the swift tidal current and the rocky shore, but at the west end the contractors have built a crib and pile dock about 55 ft. wide and 400 ft. long where all materials are received and unloaded by one of the special 65-ton, steel stiff-leg derricks with a 75-ft. boom, which is seated about 6 ft. above high tide and delivers the heaviest bridge member to a pair of standard gauge material tracks about 250 ft. long parallel to the bridge axis and about 25 ft. above high water. Cars on this track are pulled by power to the end of the storage yard, where their loads are taken by a pair of 65-ton electric gantry cranes of about 85-ft. span and 30 ft. vertical clearance that travel on tracks about 500 ft. long and store the material in piles up to 20 ft. high alongside the north line of the falsework.

General View of Substructure Looking East.

Electric Gantries.—Each crane has a pair of plate girders 5½ ft. deep and is operated by six General Electric motors distributed as follows: Two 50-h.p. bridge motors, one 50-h.p. hoist motor to each of three hoists and one 15-h.p. trolley motor. This motor capacity allows of bridge speed of 200 ft. per min.; 65 ton main hoist speed of 8 ft. per min.; 35-ton first auxiliary hoist speed of 15 ft. per min.; 10-ton second auxiliary hoist speed of 55 ft. per min., and cross travel speed of 100 ft. per min. All hoists are equipped with special automatic electric brakes in addition to the usual mechanical brakes and emergency pawls. Each crane weighs, unloaded, about 300,000 lb. and has two trucks, each with two double-flange wheels on a single rail. On the west side of the island, where the ground is highest, the rails are set close to the surface on 12x12-in. longitudinal stringers bedded in solid concrete girders with bases over 3 ft. wide, proportioned to reduce the maximum pressure on the ground to 8,000 lb. per sq. ft. On the east side of the island, where the surface is lower, the rails are spiked to cross ties resting on the flanges of pairs of 20-in. 65-lb. I-beams supported on timber bents 12 ft. apart. The bents have timber grillages seated on 3 in. of 1:2:5 Portland cement concrete.

The gantries are designed to be used either as gantry cranes in the shipping yard of the contractors' bridge shop or as bridge cranes in the shops proper after the completion of this bridge. They were made especially for this service by the Alliance Machine Co., Alliance, O., and were adopted after careful estimates and comparison with several other plans of handling the steelwork. They will handle the total weight of bridge, falsework and special traveler material and enable it to be piled higher and more compactly and conveniently than by any other method. They also cover the whole area available for storage on the island, and are estimated to have many times the efficiency of four boom derricks, which would have cost several times as much as the gantries; therefore their cost was considered to be amply justified without consideration of the saving in expense of coal and labor for operation, only two men being required to operate the two gantries, against six men for four derricks, operating only two at a time.



Gantry Cranes in Blackwell's Island Storage Yard.

The power house is a 36x136-ft. wooden frame building with timber roof trusses and corrugated iron sheathing, and contains six 80-h.p. horizontal tubular boilers built by the Erie City Iron Works; one Siemens & Halske 75-kw. 250-volt D. C. generator direct connected to a 15½x15-in. Armington & Sims engine; one 62½-kw. 250-volt D. C. Bullock generator direct-connected to a 14x12-in. Ames engine; one 245-h.p. Ingersoll-Sergeant air compressor with a capacity of 1,225 cu. ft. of free air per minute at 100 lb. pressure; a Warren & Webster steam vacuum feed-water heater and two Dean feed-water pumps. The boilers have a 4-ft. steel stack 170 ft. high. Compressed air at about 100 lb. will be distributed to the centers of both main spans through pipes from 6 to 2 in. in diameter from 3x10 ft. receivers.

At the north end of the power house there is a coal bin of about 200 tons capacity filled from boats by a boom derrick not shown on the plan. On the south side of the yard there is a 25x150-ft. wooden building containing the foreman's office, tool-room, smith shop and machine shop, equipped with drills, planers, bolt cutters and other tools operated by electric motors. The dock is long enough to accommodate simultaneously a coal barge, lighter, tug-boat and a car float 34 ft. wide and 250 ft. long with a capacity for twelve loaded cars on its two tracks. Transportation to and from New York is provided by a large tug purchased by the contractors.

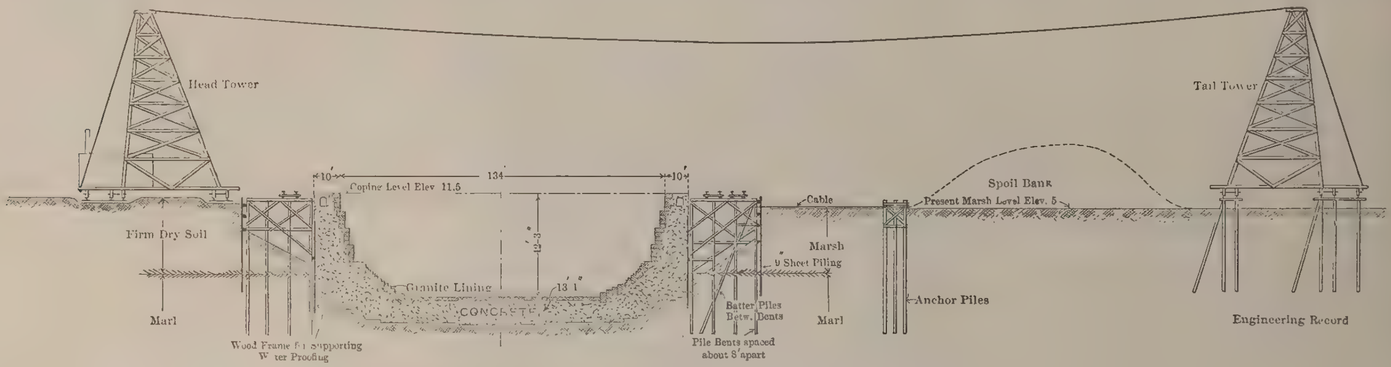
This bridge has been designed and is being constructed under the direction of the Department of Bridges of Greater New York, Mr. Gustav Lindenthal being Commissioner when the designs were adopted. The contract plans have been revised and the bridge is being constructed under the present administration, of which Mr. George E. Best is commissioner of bridges, Mr. O. F. Nichols is chief engineer, Mr. R. S. Buck is consulting engineer and Mr. Oscar Erlandsen resident engineer. The superstructure is being built and erected by the bridge and construction department of the Pennsylvania Steel Co., Mr. J. V. W. Reynders superintendent, Mr. Fred W. Cohen engineer of erection and Mr. L. N. Gross superintendent of erection.

(To be continued.)

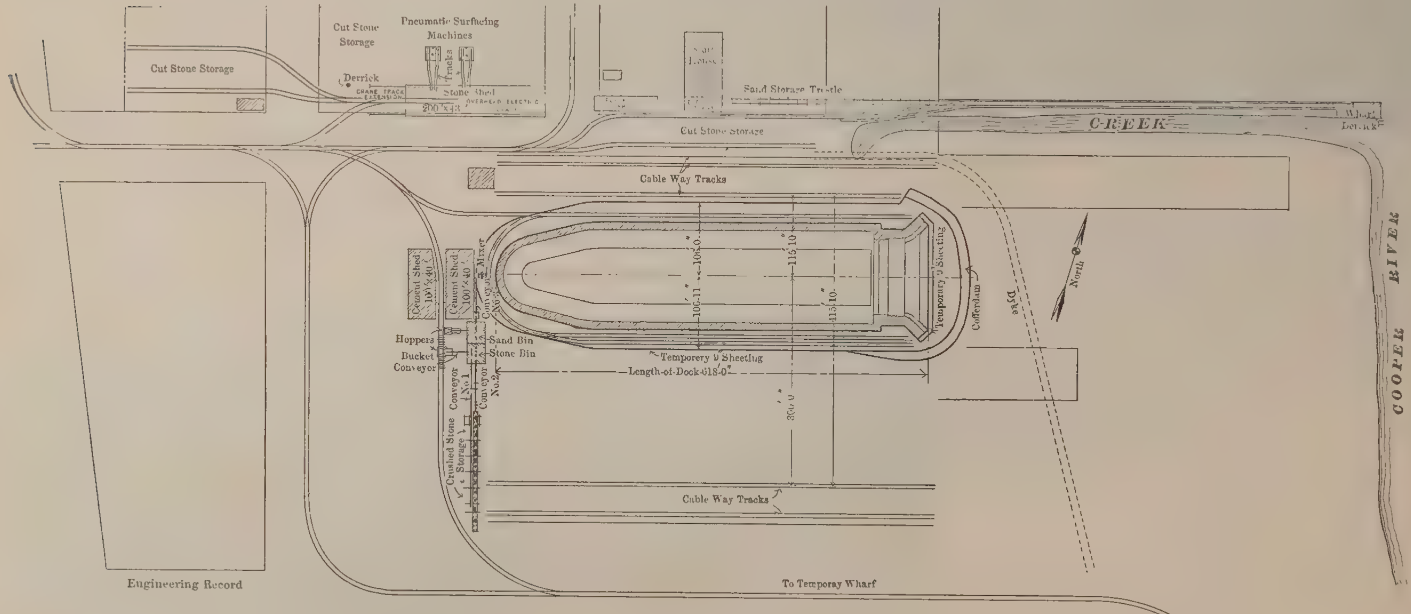
THE CONSTRUCTION OF THE CHARLESTON DRY DOCK.

A DESCRIPTION OF DIFFICULT FOUNDATION WORK.

The Charleston, S. C., United States Naval Station is located on the Cooper River about 10 miles from the sea. The river is essentially a tidal stream with but little head waters, and, therefore, not susceptible to flood. The site of the station, comprising over 1,200 acres, consists of marsh land for approximately one-half of its area, the balance being sandy soil, with an average elevation of 12 ft. above mean low water. The elevation of the marsh land is about the same level as mean high water, while the mean rise and fall of the tides is 5 ft. 1¼ in. At the edge of the marsh, adjacent to the upland, the new dry dock, No. 1, has been located, its entrance being over 800 ft. inland from the bank of the river. Ultimately, the Government proposes dredging the intervening marsh and creating an immense turning basin nearly 1,000 ft. in length. The contract for the construction of this dry dock was awarded at the close of 1902 to the New York Continental Jewell Filtration Co., Mr. John Dougherty, president. The contract price is approximately $925,000.



Cross-Section of Dock Showing Piling, Spoil Bank and Cableway.



Location of Contractors' Plant for Constructing the Charleston Dry-Dock.

The specifications provided that the dry dock structure proper and entrance to it should be built of concrete with granite facing and coping, and with a waterproof course of felt laid in asphalt along the sides and underneath a portion of the bottom. If, during the progress of the work it had been found necessary to use a pile foundation for the bottom, the driving of bearing piles had been provided for in the contract, but this was deemed unnecessary by the Government upon the satisfactory results obtained in test loads applied to the bottom when uncovered. The concrete consists of two grades, the first a 1:2:4 mixture, and the second a 1:3:6 mixture. The former is contained in the first layer, laid next to the earth, and in the final layer, into which the granite lining is embedded, the intervening concrete being of the second variety. In the side walls of the dry dock, granite blocks or boulders may be embedded in the concrete. The caisson and pumping plant are not included in the contract of the New York Continental Jewell Filtration Co. Keel blocks, bilge blocks and slides, together with composition metal fittings, are to be provided by the contractors, also bollards, winches, and the portion of the crane track embedded in the masonry wall. The dredging of a channel for the dock entrance to the river front will be done presumably on the completion of the dock; at present no provision has been made by the Government for the dredging work.

The general dimensions of the dock proper are as follows:

Length of coping level from out to out (on center line)	618 ft.	0 in.
Length of coping level from head (inside of coping) to outer sill	575 "	0 "
Length of coping level from head (inside of coping) to inner sill	550 "	0 "
Length of coping level from head (inside of coping) to abutment	530 "	0 "
Length on floor from head to abutment	503 "	0 "
Width of entrance at coping (least)	112 "	$11\frac{5}{16}$
Width of entrance at mean high water (least)	110 "	$9\frac{3}{16}$
Width of coping, in body of dock	134 ft.	0 in.
Width of floor between faces of bottom altars	80 "	0 "
Depth, coping level to mean high water	6 "	6 "
Depth, coping level to floor at head	41 "	0 "
Greatest depth from coping level to floor in body	42 "	6 "
Depth over sill at mean high water	34 "	0 "
Depth over keel blocks at mean high water	31 "	0 "
Fall, on center line of floor, from head of dock to center line of culvert	1 "	3 "
Fall, on center line of floor, from plane of abutment, to center line culvert	0 "	3 "
Fall, from center line of dock to sides	0 "	3 "

The underlying soil at the site of the dry dock consists of a so-called marl, a hard, impervious clay. It is encountered about 24 ft. below the marsh level, equivalent to 30 ft. 6 in. below the established level of the coping of the finished dock. The borings indicate that it extends downward 100 ft. or more. Test piles driven 70 ft. in length from the surface and loaded with forty tons had no appreciable settlement in this material. After the completion of excavation to subgrade, test loads were applied to the bottom to the extent of 12 tons per square foot. A triangular-shaped platform was employed in making the tests. It was supported upon three legs, each having a bearing area upon the marl of 3 sq. ft. A total load of 108 tons was placed upon the platform. The latter was built of timber, and loaded with granite ashlar. The marsh land consists of a well-saturated silt formation, which, when excavated, displays considerable mobility.

In determining the methods of excavation and the temporary protection of the banks, the characteristics of the above-described soil largely governed. As the specification of the Government provided for spoiling the excavated material upon the contiguous marshes, the methods employed were also in a measure affected thereby. The marsh land being incapable of sustaining the weight of ordinary land excavating plant, it was found expedient to remove the top stratum of soft material by means of a hydraulic pump dredge. A 15-ft. shallow tidal channel which traversed the dock site was utilized for water supply. The excavated material was discharged through pipe-lines at various points on the surrounding marsh, where mud dykes were constructed to impound it. The dredging plant for this work was constructed on the site. It comprised a 70x20-ft. scow equipped with engine, boiler, and a 12-in. centrifugal pump with the suction pipe furnished at the end with agitators or cutters. This pump dredge has excavated the marsh mud to the depth of the marl. The plant was used after the completion of the marsh excavation for the removal of the water from the dock site and for the purpose of keeping the site drained. Subsequently it was found unnecessary to use a pump of this size, and a 5-in. steam force pump has sufficed to remove all water. Simultaneously with the dredging, the construction of the temporary work for protecting the excavation was carried on so that the site could be pumped free of water upon the removal of the marsh mud and the remaining portion of the excavation carried on dry. For the latter purpose a traveling cableway was installed, having a span of about 500 ft. between towers and embracing an area adjacent to one side of the dock for spoiling a large portion of the material moved by this equipment, which will later be reclaimed for back-filling. The cableway was equipped with a 2-yd. Hayward orange-peel bucket, and the whole outfit was designed to operate a 10-ton load. It was found impossible even with such a heavy bucket to pick up a load of the marl, the latter being so hard as to scarcely engage the points of the bucket. Blasting proved necessary to loosen the material before it could be removed. The material not spoiled adjacent to the dock was placed in 5-yd. standard gauge side-dump cars and removed by locomotive to various points about the naval station and utilized for fill. As subgrade was approached, great care was required so as not to impair the bottom in blasting; the trimming being done entirely by hand with shovels and mattocks.

View of Dock Site at Inception of Work.

In locating the dock so remote from the river, one of the greatest problems in dock work, the cofferdam, was lessened, yet owing to the mobility of the marsh mud when disturbed by excavation, an almost equally important problem was involved. The method of shoring construction to withhold the marsh at the entrance end of the dock, consists of a double row of 9-in. sheet-piling, 40x50 ft. deep, tongued and grooved, spaced 14 ft. apart, and driven in an elliptical curve. The core of soft material between these two lines of sheeting was removed and replaced by suitable puddle, besides being otherwise braced and anchored, the inner circle being reinforced by batter piles driven well into the hard subsoil. Along both sides of the dock excavation, and encircling the head end, there is driven a single line of sheet-piling ranging from 40 to 50 ft. in length, and 6 to 9 in. in thickness, except along a small portion of one side, where, the ground being firm to the surface, a lighter section of sheet-piling was employed to keep out surface water. The sheeting was driven with tongue and groove splines and is braced internally by four rows of round piling from 55 to 70 ft. in depth, driven in the form of bents, on about 8-ft. centers, capped with 12-in. timber for track supports and provided with suitable cross-bracing. As the water was removed from the site by the pump dredge after the completion of the marsh excavation, the cross-bracing of these pile bents was lowered into place as the stage of the water gradually fell.

View of Work While Excavating with Hydraulic Dredge.

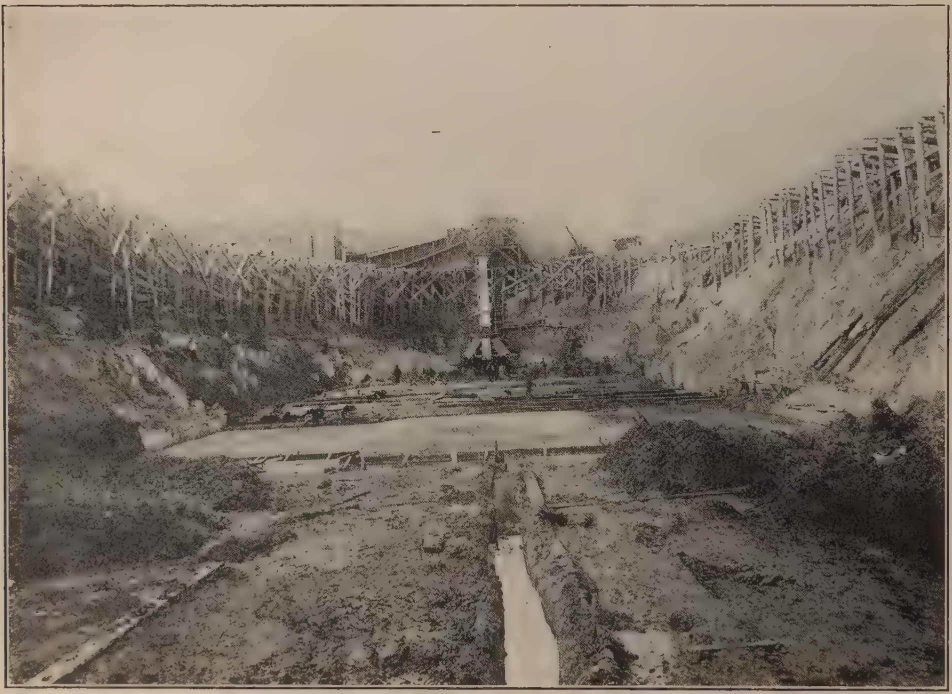
Batter piles have also been driven on the inside of the sheeting between each bent and clamped to the waling. As a further means of increasing the strength of the shoring to withhold the marsh, a number of bunch piles were driven about 60 ft. away and anchored with heavy galvanized cables to the wales of the sheet-piling. The row of round piling next to the dock prism was located so as to provide a framework for the forms required in carrying up the waterproofing and concrete in side walls. Against every second or third pile of this row was butted a pile brace about 35 ft. long, which was heeled to the initial layers of concrete extending partially across the floor of the dock. This enabled the removal of the toe of the side slopes without endangering the shoring construction. As the concrete is carried up, the pile braces are removed.

The method of handling concrete is done entirely by conveying belt machinery and elevators, a maximum output of about 500 cu. yd. per ten-hour day being obtained. The placing of concrete is being done by a chute to the bottom of the dock, and thence to place by tram cars and wheelbarrows; also by means of a double-track railway along the south side, upon which are operated flat cars carrying a 2-yd. bucket of the Cyclopean type. The cars are moved by electric motor trucks. A second cableway specially installed for this feature of the work picks up the buckets and carries them over the area being filled with concrete.

When stone setting begins, which will shortly be undertaken, the method devised consists of carrying the dressed stone in cars along the north side of the dock to any point which is desired, and thence lowering the stone to the bottom within reach of traveling stiff-leg derricks operating up and down the dock, setting all floor and low altar stones. The high altar stones may be placed by means of a locomotive crane, which forms part of the plant.

From a commercial aspect the carrying out of this work involved numerous problems regarding the supply and delivery of materials entering into its construction. The latter phase was the first encountered. At the inception of the work the naval station was without any steam railroad connections, nor were there any facilities for water service. To encompass the difficulties of rail transportation, the New York Continental Jewell Filtration Co. entered into a contract with the Government to equip the station with about 8,000 ft. of steam railroad tracks, establishing a connection with each of the two railroads operating in that locality. A private wharf was then built by the contractors on the Cooper River, with a long trestle bridge across the marsh, connecting with the dry dock construction tracks. A towboat with a gasoline engine and a number of 100-ton lighters were provided for handling freight from the city to the station. The bulk of all lumber used on the job was delivered in rafts or on lighters, which were economically handled by the above water equipment.

View after Removal of Water from Dock at Beginning of Marl Excavation.



View of Head of Dock at Beginning of Concrete Work.

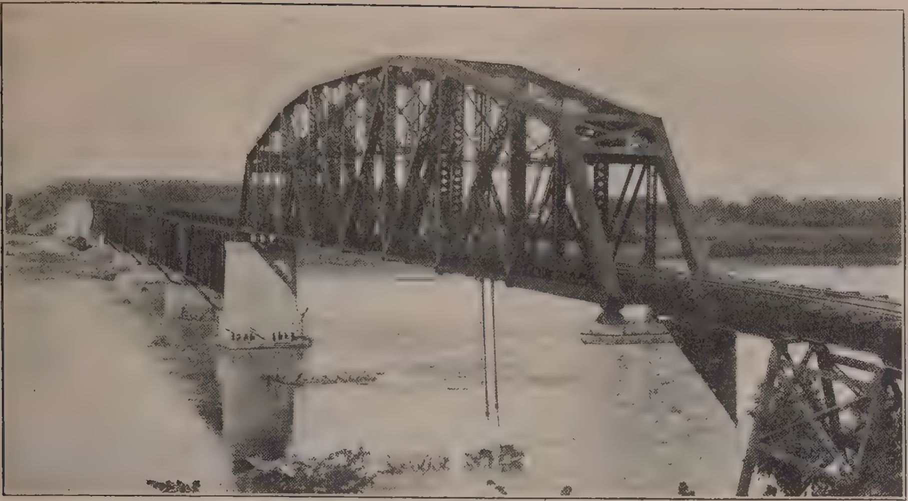
As the granite lining of the dock, amounting approximately to 8,500 cu. yd., formed the most important item of materials entering into the dry dock, great circumspection was needed to insure an adequate supply and reasonably prompt deliveries. There is an abundance of granite in South Carolina and Georgia of excellent quality. But it appeared difficult to contract for this material at reasonable figures, so the alternatives were either to purchase in New England and ship by vessel, an uncertain supply, in view of the usual dangers of the sea, and a voyage around Hatteras, or to purchase a granite deposit and open up and develop a quarry for the purpose. The latter step was adopted and active quarry operations undertaken, when it was found practicable to make arrangements with Southern granite companies to supply the unfinished dimension stone. This is delivered on cars at the navy yard, where it is dressed by the contractor's own force of cutters. The stonecutting department consists of about seventy cutters, besides attendant labor. An outfit of four air-surfacing machines and about one dozen air drills forms part of the equipment. A 5-ton electric crane handles the stone inside the shed, and a 10-ton locomotive crane outside. The stone is cut to a fine point on the treads and rough point on the rise; coping stones and caisson seats are six-cut work.

The quarry purchased by the contractors was then devoted to crushed stone and rubble for concrete there being at that time no crushing plants in that section capable of furnishing the daily quantity required. Since then several other well-equipped plants have been built and operated, from which a portion of crushed stone is now obtained.

At this writing the status of the construction work on this dry dock is approximately two-thirds completed as regards to time. The concrete floor of the dock is laid to nearly the entire length of the body of the dock, and the side walls are about to be carried up. Over two-thirds of the granite lining is delivered on the ground. All the other materials and appliances for the speedy completion of the work are at hand. As no provision has been yet made by the Government for the pumping plant and approaches for the dock, it is evident that the contractors will complete their work long before the dock can be used.

The construction of this work was conducted under the direction of Mr. Francis J. Boas, 14 South Broad St., Philadelphia, Pa., as engineer in charge for the New York Continental Jewell Filtration Co., assisted by Mr. Henry M. Dougherty as resident engineer.

The Mechanical Plant of the Baltimore American building, the rapid construction of which was described in The Engineering Record of Feb. 18, includes two 150-kw. Curtis turbo-generating units. There are some fifty electric motors of various sizes. Some other interesting facts regarding the installation are as follows: The steam boilers are of the marine type, built by the Thomas C. Basshor Co., two in number, of 150 h.-p. each, with corrugated furnaces. An American air compresor for supplying air hoists designed by the General Pneumatic Tool Co., for transferring the large rolls of paper to the printing presses, is chain-driven from a 30-h.-p. motor. The compressor has a capacity of 170 cu. ft. of air a minute, and it is used also for forcing ink to the presses and for operating a Miles pneumatic tube system. The house pumps are of the Ramsey type, each of the two provided having a capacity of 300 gal. per minute. There are two Hoe presses of an hourly capacity of 200,000 12-page papers.

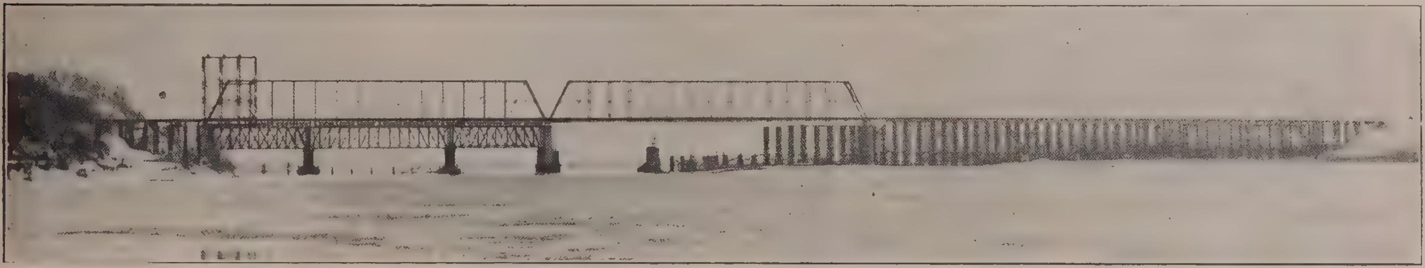


Pulling Piles by Tackle from the Completed Span.

THE ERECTION OF THE MISSOURI RIVER BRIDGE AT PLATTSMOUTH, NEB.

By F. T. Darrow, Division Engr., C., B. & Q. Ry.

The process of erecting the renewed Plattsmouth bridge (the main span of which was described and illustrated in The Engineering Record of Aug. 27, 1904), may be of interest to many.



Looking North at the Old Spans in December, 1902.

This is a single-track bridge, 1,658 ft. long, across the Missouri between Plattsmouth, Neb., and Pacific Junction, Ia., on the main line of the Burlington System, and a traffic of eighteen to twenty-five trains had to be cleared during the working period of the day. The old or original bridge was built in 1879 and 1880 by the late George S. Morison, M. Am. Soc. C. E., and at the time of reconstruction consisted of an east approach of four 30-ft. girders on iron trestle bents; three 200-ft. deck Pratt spans on masonry piers, 5/10 per cent. grade; two 400-ft. through Whipple spans on high masonry piers, level grade, and a west approach of four 30-ft. deck girder spans on a sharp curve.

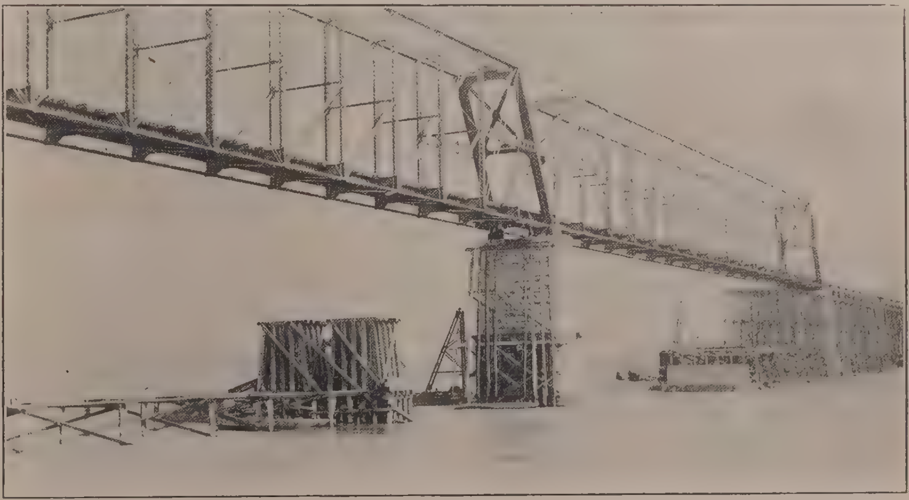
The rebuilt bridge consists of a 21-ft. girder span on piles and a 90-ft. deck girder as approach; one doubled-up 200-ft. deck Pratt span made from the old bridge; two new 202-ft. deck Pratt spans, all on 4/10 per cent. grade; two 197-ft. 8-in. deck Pratt spans and one 401-ft. 6-in. through subdivided Pratt span on level grade, and a level curved west approach of two 48-ft. girders separated by a 30-ft. tower.

The minimum clear height for navigation under the big span is 50 ft.

All the old piers of the bridge were rebuilt or remodeled and one new pier was sunk to bed-rock. The new pier was sunk to a depth of 52 ft. by the pneumatic process from January to March, 1902, and the granite shaft built above high water.

In July, 1902, the falsework was begun, boats built and delivery tracks for material were laid.

The east approach falsework consisted of two single and two double bents of piles driven by a track-driver, and one framed bent on piles at pier 6, which was replaced by a wide bent after the pier was rebuilt. The old 30-ft. approach girders were removed with a derrick car (of which three were used on the job, two home-made and one Bay City Industrial Works), and 8x16-in. wood stringers placed on the bents to carry the track.



Building Pile Bent at Pier 2.

The 90-ft. approach girders were unloaded and landed in place beside the track on the long bent at one end and a crib of 12x12-in. timbers at the other. These girders weighed 32 tons each and were handled by a derrick car at one end and a single A-frame spanning the track at the other end. These girders were riveted up and ties placed ready for the rails. They were then pulled into place from the side by double-geared crabs placed between the girders, the line being attached to the end of the caps supporting the span. A rail placed on the cap and greased facilitated the sliding.

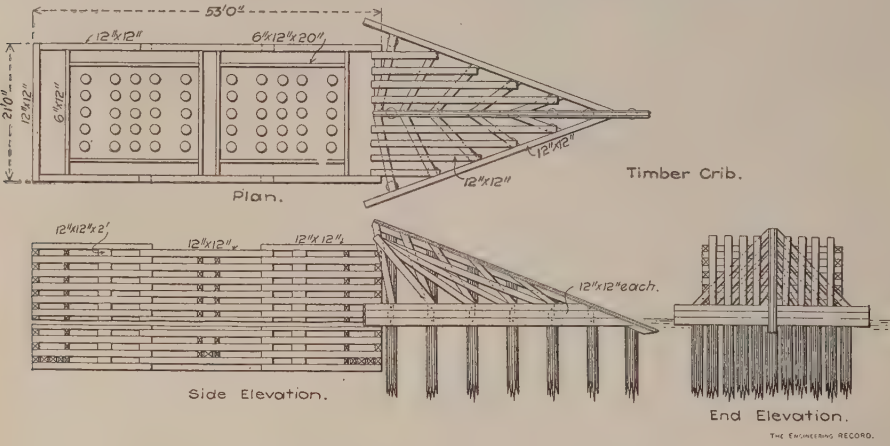
Pier 6, of stone, was torn down with bars, plugs and feathers, and a derrick car. The pit was excavated 9 ft. deeper and eighty-nine piles driven in the pit and the new concrete pier erected on them. Owing to the depth, the water contained in the sandy soil made excavation difficult and three rows of sheeting were required before the final depth was reached. No pressure pump being at hand a jet of air was used to take the last row of sheeting to the required depth. The falsework here was a bent of piles driven by a land driver on each side of the pier. These carried framed bents to the height of the pier and four old 25-ft. girders were placed on them spanning the pier and three framed bents were erected on the girders to carry the track.

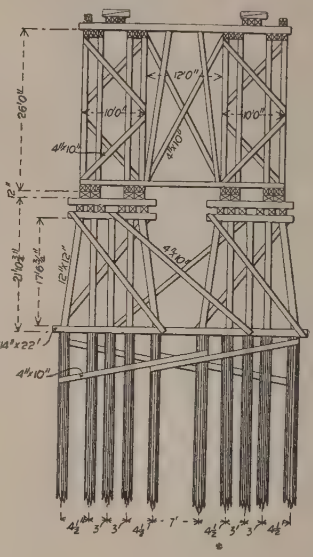
Under the span between piers 5 and 6, fourteen framed bents of 12x12-in. posts and 12x14-in. caps and sills were erected; the lower deck clearing the bottom chord, the upper part having posts 30 ft. long. These bents were on old blocking laid on the ground and serving as mud-sills, except one bent at each pier which was on piles. The posts of these bents were all plumb to allow the two old spans to be doubled up. The falsework was put in largely by hand with small blocks and falls, although hoisting engines were used when handy.

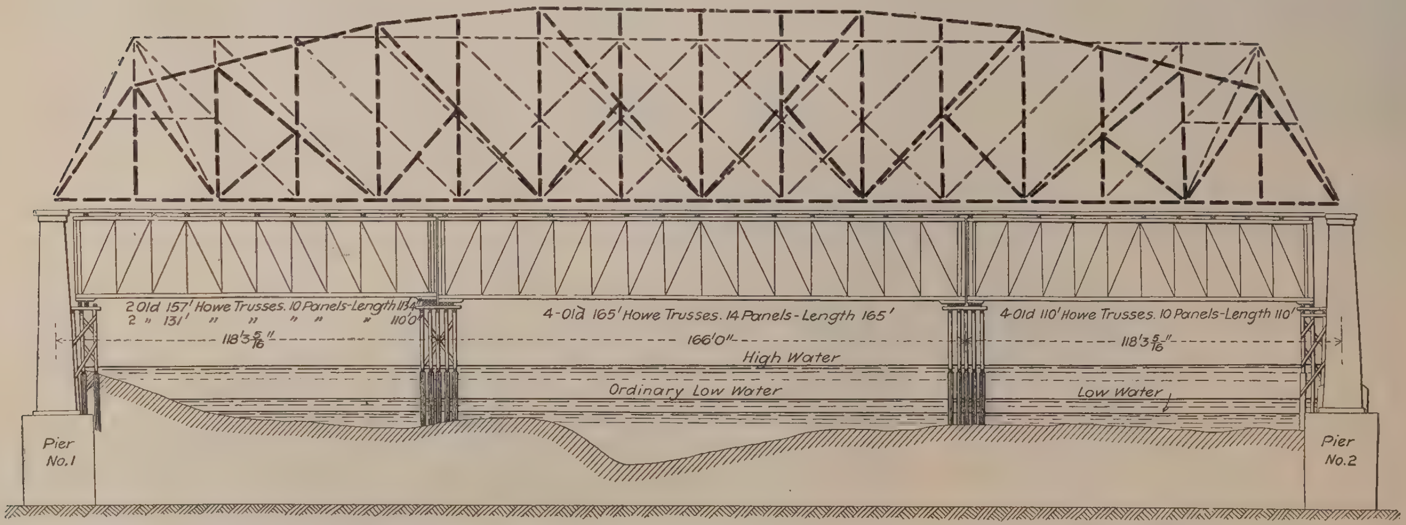
The old floor system carrying the track was raised on the falsework to clear the trusses, which being then free were lowered about 2 ft. to their new elevation and were pulled in to 10 ft. centers instead of 16 ft.; the old bottom lateral system and sway rods being rebuilt to fit. Span 4-5 was taken apart, the smaller parts being handled by hand; the top chords and posts being picked up by a derrick car, carried to span 5-6 and landed in position on the falsework at 16 ft. centers.

The two spans were connected by plates on both sides, top and bottom of interior posts and at the middle of the end or batter posts. The floor-beams are riveted to equalizing beams at each end, and these distribute the load to each pair of trusses. The Bay City derrick car, with long straight boom, was used in changing the floor; carrying out the old stringers and beams and bringing in the new floor-beams, stringers and ties. This was of course done between trains, a full hour being required to change one 25-ft. panel of the floor.

Pier 5 was torn down and rebuilt of concrete from the top of the old footing, which was found in good condition. The old cofferdam or caisson was still in place and in good condition, so no other was built. The track over the pier was supported, as at pier 6, by three bents on girders which rested on framed bents built on bents of piles driven just outside the caisson. After the new pier was completed the girders spanning the pier, together with their bents, were removed and two full-height bents of piles were set up on the footing to carry the track while the spans were being put in. The old pier was cracked, but had been banded with rail bands in 1891.






2 Old 157' Howe Trusses. 10 Panels-Length 113¾'
2 " 131' " " " " " 110'0"
4-Old 165' Howe Trusses. 14 Panels-Length 165'
4-Old 110' Howe Trusses. 10 Panels-Length 110'
118'3 5/16"
166'0"
118'3 5/16"
High Water
Ordinary Low Water
Low Water
Pier No. 1
Pier No. 2
The Engineering Record

Span 1-2.

Arrangement of Pile Piers and Howe Trusses for Span 1-2.

The new concrete was mixed by a one-yard barrel mixer turned by an engine which also handled the material to the mixer and hauled the concrete to place in a one-yard car.

Pier 5 has recesses on the west side to receive the pedestals of the new span, which is deeper than the old doubled up spans.

The falsework of span 4-5 was built on blocking for mud-sills except one bent at pier 5 and two bents at pier 4, which were on piles driven with a land driver. The bents had inclined outside posts and were erected as at span 5-6. There were six posts in each bent, and the upper story had plumb posts 33 ft. 4 in. long, so that the process of weaving the timbers into the old span, taking out the old span, weaving the new iron into the falsework and again taking out the wood was a slow but interesting one.

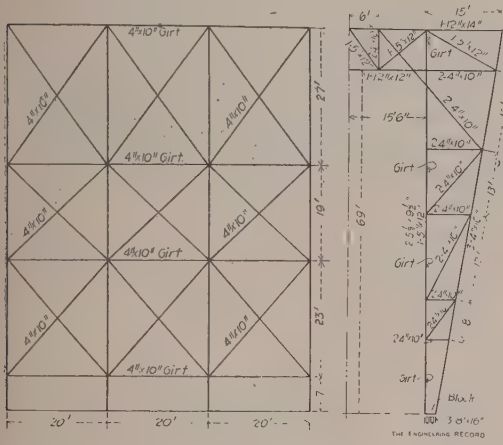
Span 4-5 was the first one erected, the top chords being placed about Jan. 1, 1903. The posts, chords except bars, end posts, tower bent and castings were placed by derrick cars, and the bars, sway rods and struts were put in by hand with block and falls. The floor was put in with derrick car, as on the other spans.

Pier 4 is the deepest pier of the bridge and was sunk by the pneumatic process in 1879, as were also piers 2 and 3. The stone masonry was taken down to the concrete-filled crib and the new concrete pier erected on this; the method of mixing and placing concrete being similar to that used at piers 5 and 6. A bent of piles on either side of pier 4 carried the high bents, which, with cribbing on top, carried the old track stringers. The feet of the end posts of the old span were carried on 12x12-in. timbers spanning the opening over the pier. Excavation here was carried on inside a cofferdam of two rows or courses of 2-in. plank rammed down with a heavy timber lifted by hand and dropped.

Eight piles per bent were driven under span 3-4 and cut off near the surface, which here was low and sometimes overflowed. The bents were like those of span 4-5, the long posts being above to permit putting in the new iron.

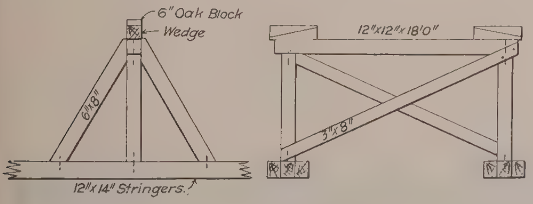
The old span here was the last removed, and the new span was coupled up during the June flood of 1903, when water was flowing under the span. Fortunately it did not scour any under this span, although nearly one hundred piles were taken out under the next two spans west. This span was put in like the span east, heavy pieces with derrick-cars, light parts with small blocks and falls.

Pier 3 being a high pier supporting one end of the old 400-ft. through span, had to be torn down. A pneumatic rock-drill and powder were found of great use here. The pier was taken down nearly 45 ft. and new sandstone belt and coping courses put on. The old iron track stringers at the pier were supported on the adjacent bents and the space between the stringers was filled with wooden stringers across the opening. A stone derrick operated by a hoisting engine nearby and the derrick car were used to handle the stone here. Span 2½-3 had falsework like 3-4 but with eight piles, and eight posts per bent instead of six. This span was over a bar at the edge of the channel. The falsework was erected with a hoisting engine on the pile-driver boat nearby. Being under the old through span the bents were put together flat and raised to position. Stringers were placed on top of the bents and long 12x12-in. caps placed on these with ends projecting, to carry the traveler run. On these caps 12x12-in. cribbing was placed to carry the old floor system. In changing the floor the cribbing was removed and the new floor placed directly on the new deck span which had been put in place before changing the floor. The new span was erected after the old 400-ft. span had been removed and the traveler taken down. The derrick cars were used to place the iron. The falsework was taken down by slacking the pieces into the water which then covered the bar, or picking them up with the derrick car from above. Most of the piles under this span were washed out, leaving part of the falsework hanging in the span as shown in one of the photographs.



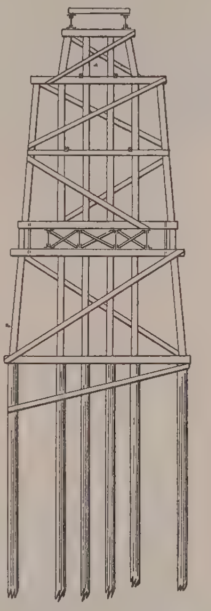
Traveler for Work on Main Span.

THE ENGINEERING RECORD



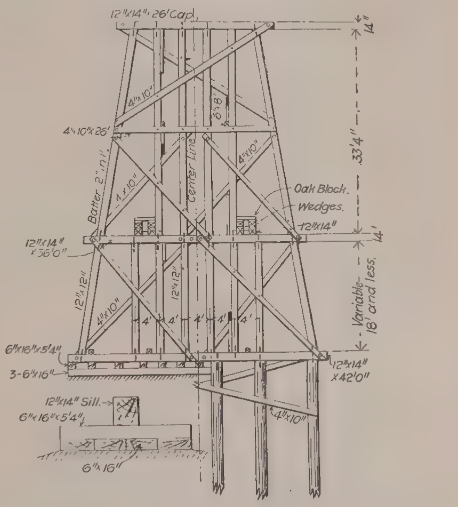
Pony Bent for Supporting Old Trusses during Erection.

THE ENGINEERING RECORD



Elevation of Bent W at Pier 5

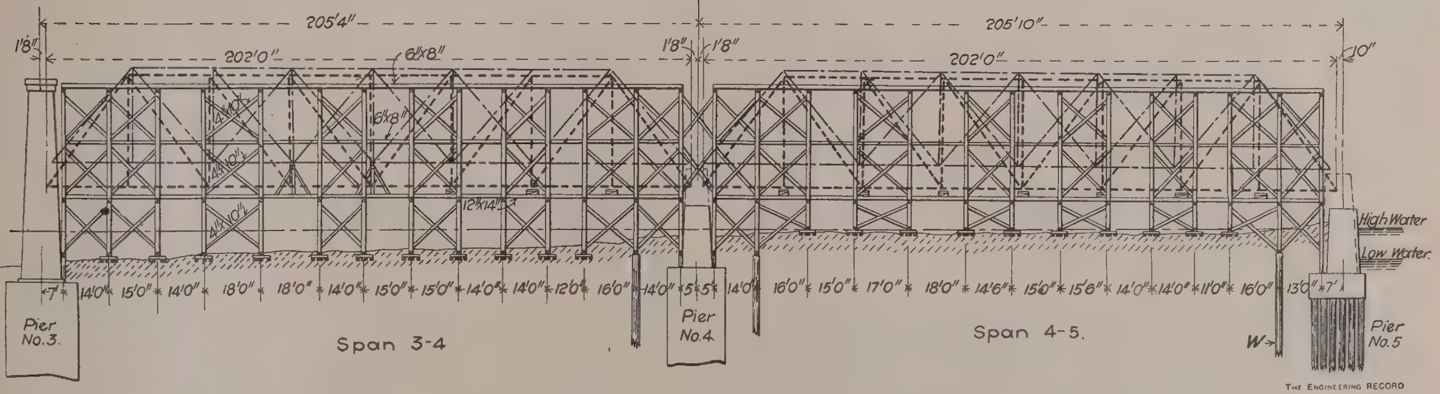
THE ENGINEERING RECORD.



Half Elevation showing Piles Supported on Mud Sills

Half Elevation showing Bents Supported on Piles

THE ENGINEERING RECORD.



Arrangement of Falsework on Spans 3-4 and 4-5.

THE ENGINEERING RECORD

It was originally intended to drive piling for all the falsework under span 2-2½, but soundings at pier 2 showed the rock to be bare, so two old 125-ft. Howe spans were placed, side by side, next to pier 2, making a single 125-ft. opening so that new deck trusses at 16 ft. centers would come between each pair of Howe trusses. The falsework between pier 2½ and the Howe span was like the preceding span and built on piles. Temporary pier 2¼, at one end of the Howe span, consisted of four bents of piles surmounted by framed bents to form the bridge seat. This pier, as also temporary piers 1⅓ and 1⅔, was protected by a "cocked hat" cut-water of seventeen piles, capped by 12x12-in. timbers. A brush mat was sunk around it and several cars of rock dumped on top. The Howe spans were erected by a hoisting engine on the boat, the chords being laid on hangers or suspenders made of 12x12-in. timbers hung with rods from the old span above. Above the trusses long caps for the traveler run and cribbing to carry the floor system were like the rest under the old 400-ft. spans.

The falsework around pier 2 in midstream presented the greatest difficulty. The current was strongest here and soundings showed the rock to be bare. About 1899 a layer of concrete was put around the pier from below water to nearly high water, being held by a wide band of boiler-iron. Into this concrete notches or steps were cut and a framed bent, with posts resting in the steps, was erected on each side of the pier and tied together around the ends of the pier. As piles could not be driven, owing to the character of the bottom, a bent of eight 50-ft. piles was built on each side of the pier in the air, braced and capped, the whole being hung from the old spans. These bents with a cable attached to a large stone upstream as an anchor, were lowered to rock and a crib built around them. The piles did not all come to a full bearing at first but by hammering with the pile-driver and by resetting, they were finally made firm and the crib filled with rock. The top of the stone pier was torn down five courses and new belt and coping courses put on. The old rock removed with the derrick car was slid off from chutes into the river around the upper end of pier 2 and the temporary piers 1⅓ and 1⅔. At these piers brush mats were built on the ice and sunk through it by loading with rock and sawing the ice.

The old east 400-ft. span was taken down with the traveler and derrick car (after the new west span had been put up) and the traveler was then run to the new 401-ft. 6-in. span and taken down there.

The new span 2-2½ was erected with the derrick car; the bottom chords resting on hangers depending from the Howe trusses and the top chords being blocked on the traveler run caps. The pieces of the Howe trusses were taken down to the boat or thrown into the water and rafted or were lifted up by the derrick car.

The falsework of the 401-ft. 6-in span consisted of three lengths of old Howe spans, 110 ft., 165 ft., and 113 ft. long resting on piers of five 10-pile bents surmounted by framed bents for bridge seats. These piers were protected by rock-filled cribs, cocked-hat ice-breakers, brush mat and rock. The inside trusses were 12 ft. apart in the clear and the outside trusses 32 ft. out to out, with 12x14-in. by 34-ft. Oregon fir caps to carry the traveler run, old and new spans and the traffic. Two inclined posts were set up on sills on the lower chords and extending up to the middle of the traveler run caps.

The Howe spans 1-1⅓ and 1⅓-1⅔ were erected on temporary three-pile bents and the spans 1⅔-2 were built on suspenders or hangers from the old span above. They were all removed by the use of hangers and the parts lowered by the hoisting engine on the pile-driver boat below and taken ashore.

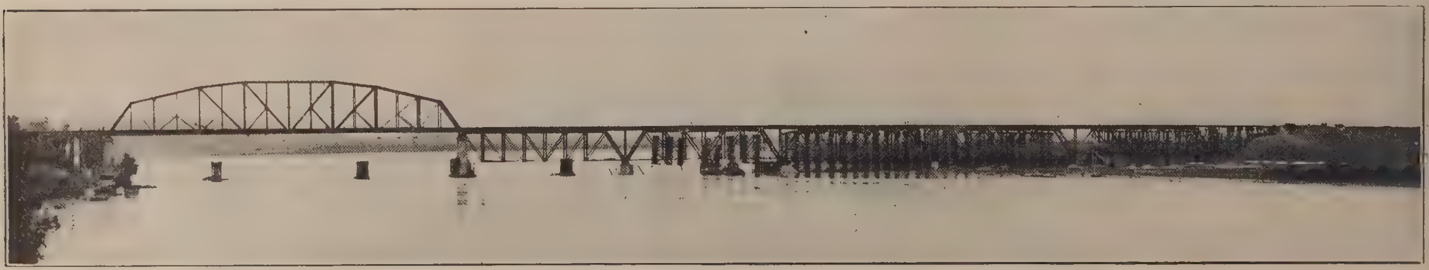
The cribs and piling of these temporary piers were pulled with two-inch lines rove in triple blocks hung to the new span above and operated by the engine on the boat or by a double-geared crab worked by hand on the bridge. They were pulled with great difficulty. The strong current had made driving difficult also and when driven the piles would weave around until capped. The boats were operated by lines to the piers or to anchors up-stream. Pier 1⅓ was driven in the old mass of rip-rap surrounding the temporary pier used in the original construction of the bridge.

On the stream-side of pier 1 a bent of ten piles was driven to the ground surface. One framed bent on the piles and two on blocking formed the bridge seat for the Howe spans.

Three courses of stone were removed and new belt and coping courses added. Both here and at pier 2 the ends and middle of the pier were torn out and then the pedestals carrying the end posts were gradually undermined and carried on timbers on the falsework. The new courses were then laid.

The west approach is on a sharp curve. The falsework consisted of four 5-pile bents driven with a track-driver, and four framed bents on five piles driven with a land-driver, and one framed bent at pier 1 on blocking for mudsills. Cribbing was used on top of the bents to carry the old floor.

The four new concrete piers for the tower were carried down into an impervious, stiff, dark red clay several feet lower than the old piers.

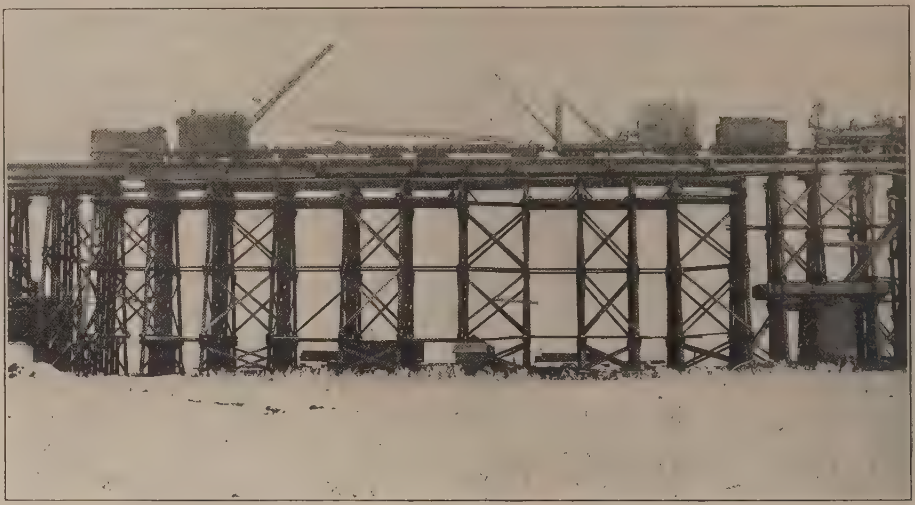


View Looking North at the New Spans While Falsework Was Hanging from Span 2½-3.

The west abutment, of limestone, was torn down 13 ft. and replaced by a new concrete abutment built on the lower part of the old one which was not removed.

View Looking East on March 14, 1903.

The 48-ft. girders of the west approach were set out on the long caps on the outside of the curve and riveted up, ties laid and centers run for the curve. Track and old girders were then taken out with the derrick car and the new girders were slid into place. The girders are inclined normal to the elevation and rest on the tower posts (which are of different heights), and on castings (also of different heights) at pier and abutment. The 30-ft. girders rest on steps or brackets on the end of the 48-ft. girders. All these girders and tower pieces were handled with derrick car and the falsework here was largely taken down by the same means.



Derrick Cars Taking Up Old Top Chord, Span 4-5.

The traveler used on the two old 400-ft. spans and the new 401-ft. 6-in. span was of four bents and was 31 ft. wide by 64 ft. high in the clear, with sills 63 ft. long. It was rebuilt from the Quincy, Ill., bridge traveler. The sills were three 8x16-in. timbers, with two wheels on two tracks at each post. It was erected by rolling the cap up the west end posts to the top chords of the west old span, then raising the upper end of the legs to the cap, the foot of each leg resting on the sill on its track. When the bent was bolted together in this inclined position it was raised to the vertical by lines to the old span. All four bents being raised they were braced together. The traveler was about 135 ft. above the water at the top, and contained some 55,000 ft. B. M. of lumber. It was moved by lines attached to the traveler run and led to the erecting engine.

The trusses of the west old 400-ft. span were taken down with the traveler and derrick-car and the traveler was then taken to the east 400-ft. span while the derrick car was used in changing the floor of the west span. This done, the traveler was returned to the middle of the west span and erection of the trusses was begun. These were erected from the middle to the west end and then from the middle to the east end and the traveler then began taking down the trusses of the east old 400-ft. span.

Two-inch lines in large four-sheave oak-framed traveler blocks set on the straining beams or "jigger-sticks" above, were used to handle the top chord and end posts to place. Eleven lines in all were used on the traveler. The motive power was an 8-spool erecting engine anchored on a rock-filled crib on the west bank of the river and at the south end of pier 1 for the west span, and the same engine placed on the boat was used to take down the east 400-ft. span. The heaviest load to be raised was a section of top chord weighing nineteen tons.

On account of the constantly increasing weight of the growing span, the camber originally put into the floor was taken out by the settlement of the Howe spans and to make the pin connections it was necessary to check over the camber frequently.

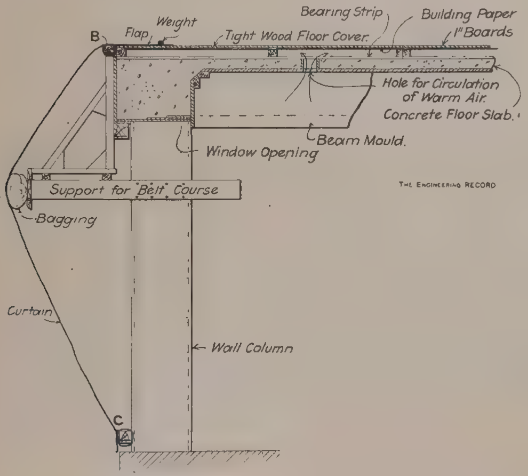
Floor-changing on the 401-ft. 6-in. span began Feb. 14, 1903, and was completed Feb. 20. Truss erection began Feb. 22 and the last coupling was made March 9.

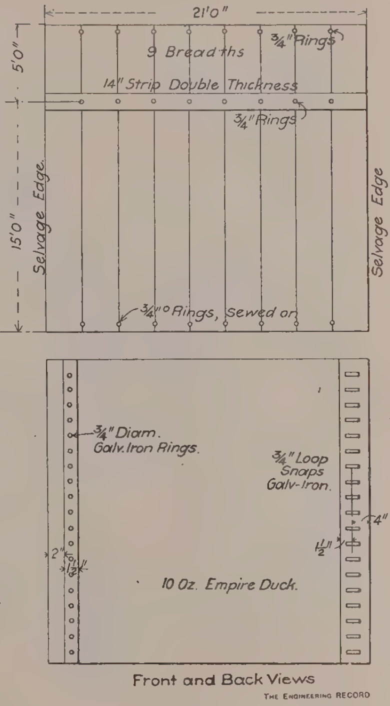
The general break-up of the ice began on March 7 and the work was carried on almost continuously until the last pin was in place at 1.30 P. M., March 9. Fortunately, however, the break-up was an easy one and no damage occurred beyond the loss of the ice-breaker at temporary pier 1⅜. This did not take place until after the span had been coupled up and was ready to swing. The span was coupled up and swung to bearing, then blocked and riveting was begun with air hammers on the 19,000 field rivets of this span, 55,000 in the whole bridge.

The air plant consisted of two compressors, one on each side of the river. The west one was a remodelled Pangborn pump and the east one a 12x12x12-in. Smith Vaile water-jacketed compressor. Air was used for four hammers, forges, two drills, one rock drill and two holdons. A working pressure of 75 lb. was maintained.

The bridge was given two coats of Prince's mineral paint after erection. The old doubled-up spans were cleaned with lye and thoroughly washed.

The telegraph wires are carried on three regular pattern cross-arms which are bolted at one end to a short post attached to floor-beams every 100 ft. The top cross-arm is about 4 ft. above the track. A small angle iron from the foot of the post forms a brace to hold up the outer end of the arms.





Front and Back Views

Curtain and Wood Covers for Fresh Concrete Columns and Floor.

The ties are 8x8-in. by 10 ft. except on girders, with every fourth tie an 8x8-in. by 14 ft. projecting on alternate sides for the wire hand-rail support and the sidewalk. All ties are provided with 7½-in. tie-plates.

The timber used in the falsework was Washington fir from Puget Sound. Over 1¾ million ft. B.M. were used, besides the eight old Howe spans.

The plan of the new bridge was worked out by the late Mr. E. J. Blake, M. Am. Soc. C. E., as consulting engineer of the Burlington System, and carried to completion under the direction of Mr. C. H. Cartlidge, M. Am. Soc. C. E., bridge engineer of the Burlington System. Mr. I. S. P. Weeks was chief engineer of the Burlington & Missouri River R. R., by which company the work was done, with Mr. J. C. Sheahan as superintendent and the writer as resident engineer. The new pier 2½ was sunk under the direction of Mr. Geo. Adgate, M. Am. Soc. C. E., as superintendent and Mr. H. H. Ross as engineer.

Safeguards for Laying Concrete in Frosty Weather.

When it is necessary to lay concrete in very cold weather the precautions usually taken to prevent its freezing before setting include heating the water used in mixing, the addition of salt to it, covering the concrete with tarpaulins and sometimes heating the sand and broken stone. When the concrete is designed to develop high unit strength, as in the reinforced beams, girders, columns and floor slabs of factory buildings, where it may be subject to heavy stresses or vibrations, it is especially necessary to insure it against any danger of injury from cold, and some interesting methods of protecting it have been developed in the construction of a number of large factories built during the past few winters which have enabled the work to be carried on outdoors when the temperature was very low without any evidence of imperfection or loss of strength in the concrete.

A group of large buildings for a piano manufacturing plant at Despatch, near Rochester, N. Y., is made wholly of reinforced concrete of the Ransome system, and includes one 80x450-ft. two-story building with an 80x120-ft. wing, five duplicate 50x200-ft. three-story buildings and several other structures. The contracts were not awarded and work got under headway in time last fall to complete the principal buildings before freezing weather, and provisions were made for carrying on the work vigorously through the very cold weather which prevails in that locality for several months every year, the winds from Lake Ontario sweeping over the site and increasing the severity of conditions when the mercury is often near zero for weeks at a time and frequently falls below zero.

To provide a supply of 100 cu. yd. of gravel and half as much sand per day for the concrete mixer, a storage bin was constructed about 16 ft. square outside and made with the bottom inclined about 45 degrees. The walls, with their upper sides parallel to their lower sides, were made with 16-ft. vertical planks, thus making the vertical elevations of the ends and sides of the bin, rectangles and oblique parallelograms, respectively. The bin was divided into unequal parts by a vertical partition parallel to the sides and the larger space used for gravel and the smaller one for sand. A set of ten 3-in. old boiler tubes clamped together and arranged side by side in a horizontal plane crossed both chambers of the bin, transversely about 5 ft. above the lowest point in the floor and about 2 ft. from the lower end wall. Where the pipes pierced the partition and side walls they were enclosed in concrete to protect the woodwork from the heat, and they were supported on bearing pieces. When the bins were filled with sand and stone these materials formed slopes under the edges of the tubes, leaving an open space there of approximately triangular cross-section, roofed by the layer of tubes. This space was utilized as a flue, and hot air forced through a coke furnace by a Sturtevant No. 6 blower was delivered to it through a 6-in. pipe inserted through the side wall of the bin. The 3-in. boiler tubes were to be closed and live steam circulated through them in case further heat was needed. Parallel to the boiler tubes was a 2-in. pipe run through the lowest part of the bins and provided with half a dozen 2x¾-in. open crosses, through which and the open end live steam is injected through the mass of materials. Although the top of the bin is not closed, and the sand and gravel are therefore exposed to rain and snow, this arrangement has sufficed to keep them unfrozen, and it was not necessary to pass steam through the boiler tubes. The scheme was somewhat experimental, and the set of tubes was placed near the lower end of the bin, with the expectation that it would not suffice to warm the materials sufficiently, and that one or two more flues would be similarly constructed dividing the space above it into equal portions, but these have been found unnecessary.

Water is stored in two 1,000 gal. wooden tanks filled through ball cocks and heated by live steam blown in through perforated pipes which maintains a temperature of about 90°. One tank contains pure water only and is used in moderate weather; the other tank is fitted with a partly immersed rack on which is kept an abundant supply of salt. This readily dissolves and constantly maintains a saturated solution, which is fed automatically to the mixer in any required proportion by a Ransome measuring tank. A larger measuring tank controls the supply of pure water to the mixer. The measuring tank is a vertical steel cylinder 16 in. in diameter and 3 ft. long supported on a vertical pipe passing through the center of the bottom. The lower end of the pipe terminates in a flange screwed to the floor to form a pedestal, and between it and the tank there is a cross with one valved outlet to the supply and another valved outlet to the mixer. A long thread is cut on the upper end of the pipe, and the bottom of the tank is tapped to correspond, so that it can be screwed up or down nearly the full length of the cylinder. The pipe serves for both inlet, outlet and gauge. When the tank is screwed up to its highest position the maximum quantity of water, equal to the entire contents, is delivered, and when it is screwed down to its lowest position, only the minimum amount can escape over the top of the pipe. In operation the tank is filled by opening the valve on its supply pipe; this valve is then closed and the valve on the mixer pipe is opened and closed again as soon as the contents are discharged, the tank is refilled and so on, an air valve in the top operated automatically by a float being provided to prevent the formation of a vacuum in the tank.

Duplicate construction is simultaneously carried on in two of the 50x200-ft. buildings, and each story is successively enclosed with a temporary protection moved from one to another, which is designed to confine warm air in contact with all freshly laid concrete surfaces, and provide sufficient circulation for it to prevent the danger of cold spots occurring at any points. In the improved structural system designed by Mr. E. L. Ransome and adopted for the buildings, the floor platforms are made continuous to the outer faces of the walls, making projecting belt courses on which the panels of light outer walls are carried in one-story sections, built at any convenient time after the completion of the floors. The column moulds are set upon the finished floor and with the auxiliary falsework support the moulds for the floor above, which are fitted so tightly together that they make an almost watertight roof over the whole story. The open panels between the wall columns are closed by sectional curtains tied to the falsework, top and bottom, and heating apparatus is installed inside before concreting is commenced. First the column moulds are usually all filled in a single day, and the upper surfaces covered with canvas or any convenient protection. Afterwards, as fast as the beams, girders and floor slabs are made, their upper surfaces are covered by flat wooden panels like sectional flooring laid on the concrete and raised a few inches above it to leave shallow spaces for warm air which is confined there. All parts of these appliances are made in standard interchangeable units readily fitted together and moved from story to story as the work progresses.

The curtains are made, as shown in the sketch, with strips of 12 oz. Empire duck 28 in. wide, sewn together with lap seams like sails and reinforced by narrow strips of double thickness where the galvanized iron fastening rings and snaps are attached with eleven-fold twine. At first the curtains were laced together through double rows of brass eyelets on the vertical edges and had a single row of the same on the lower horizontal edge, but these were found less satisfactory than the fastenings shown on the sketch. The curtains are secured in position by tying them through the bottom rings to a continuous horizontal bar C attached to the feet of the wall column moulds, and by tying the intermediate row of rings to the top bar B. The curtains slope outwards to enclose the supports and braces projecting from the face of the wall for the belt course moulds, and the ends of the timbers are padded with burlap, canvas or any convenient material to prevent danger of their sharp corners cutting through the curtains. The upper edge of the curtain extends 5 ft. beyond the upper connection and forms a flap which is folded over horizontally on top of the cover panels or floor moulds to seal the joint, and is usually kept in place by lengths of reinforcement rods laid on the edge; the last row of rings not being generally used.

The air in the enclosed story is warmed by coke fires in open braziers usually made of vertical and harizontal bars of twisted reinforcement bars ½ in. square wired together 2 in. apart. Each will hold about five cubic ft. of coke. Ten braziers were used in each 50x200-ft. story, 13 ft. high in the clear, and, with the steam pipes, maintained a temperature of about 80° under the floor moulds and not less than about 40°, as indicated by self-registering thermometers, in the spaces between the floor slabs and the cover panels, although the mercury frequently stood at + 10°, and sometimes fell below 0 outside.

The 10x10-ft. cover panels were specified to be made with 12x1-in. boards, 10 ft. long, with three 2x3-in. transverse battens nailed to them edgeways at the ends and across the centers. Three 6x1-in. longitudinal strips were nailed flatways across the lower edges of the battens to afford a wider support on the soft concrete and diminish the pressure there. The lower sides of the panels were covered with building paper, closing all cracks between boards. The panels were set close together but were not fastened together.

A 2-in. riser supplied steam at about 100 lbs. from the 35-h.p. boiler for the office heating plant, to the storage bin tubes and to a system of pipes blocked up about 6 in. above the floor of the enclosed story. Two longitudinal pipes were carried from end to end of the building, midway between the rows of intermediate and wall columns, and were perforated at frequent intervals to discharge steam into the room.

The curtains and steam pipes are intended to be used as permanent plant available on future work after the completion of this contract. The floor cover panels were usually made of any convenient stock or waste boards available, maintaining the outside dimensions but regardless of the thicknesses and lengths specified, and were destroyed or their materials used for other purposes after the former jobs were completed.

Mr. Henry Ives Cobb, New York, is the architect of the buildings, the Vanderbilt Improvement Co., Rochester, N. Y., is the owner, and the Foster-Armstrong Piano Co., Despatch, the lessees. The Ransome & Smith Co. are the general contractors, and the designs were made and the work executed under the supervision of Mr. E. L. Ransome of that firm, who also devised the heating and protection apparatus here described. The details of the structure and of the apparatus were principally worked out by Mr. F. V. Lawrence, assistant engineer.

BAGS OF SILT were used in preparing the foundations of temporary silt and rubble dams at the Asyut dam across the Nile, to serve as cofferdams to protect the site during construction. The greatest height of these temporary structures was 32 ft.; their top width was 16 to 27 ft. and their slopes were between 3:1 and 6:1. The material was of poor quality for this work, and, owing to the disputed question of the value of bagged silt for such purposes, it is interesting to learn from the report of the chief engineer, Mr. G. H. Stephens, that half of the silt in the bags oozed through the canvas and disappeared. While silt seems to be a good, tight material when it can be confined, it is almost as hard to confine as water itself.

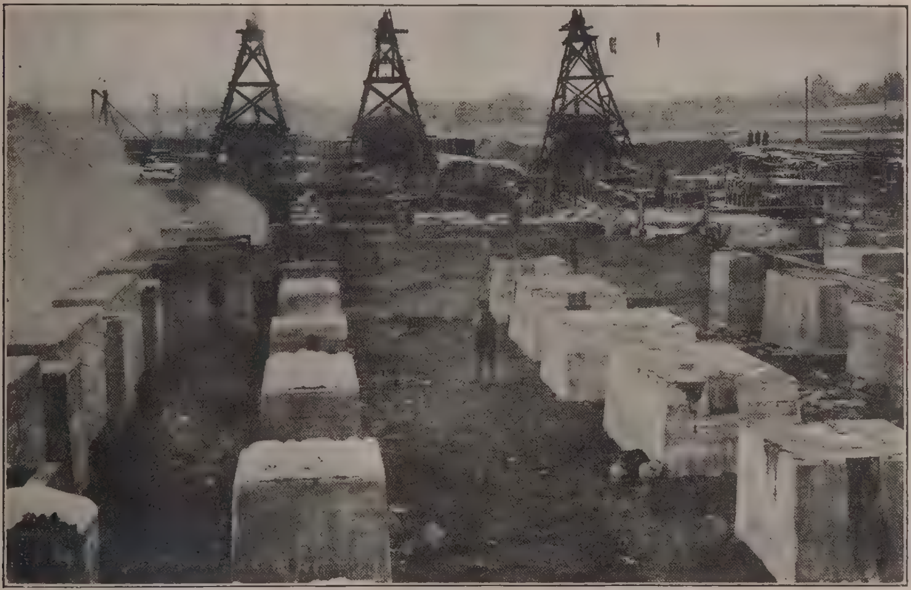
Construction of the Port Morris Power House for the New York Central R. R.

The 30,000-kw. power house for the generation of electricity for the Harlem Branch of the New York Central System, will have an initial installation of four 7,500-h.p. turbo-generators in a 238x168-ft. fireproof building corresponding in plan and arrangement to that illustrated in The Engineering Record of Dec. 10, 1904, for the twin plant at Yonkers. It will differ from the latter chiefly in the concrete footings which, instead of resting on piles, will be carried down to solid rock. Independent foundations are built for the walls, columns and machinery, and the spaces between are filled with earth, except the upper 12 in., which is cinder and finished with a 6-in. concrete floor. The principal quantities involved are about 42,000 yd. of earth and hardpan and 9,500 yd. of rock excavation, 24,000 yd. of back fill, and 20,000 yd. of concrete, which, unlike that at Yonkers, is made without reinforcement.

Cableways and Moulds Used on the Foundations of the Port Morris Station.

The site is a marsh on the north bank of the Harlem River about 1 mile from the Mott Haven depot of the New York Central R. R., and its surface was originally about at high-tide level. At one side of the site there is the outfall of a sewer, built across the marsh on an embankment which serves as a cofferdam to exclude the river water from that direction. The end of the embankment was rip-rapped by the contractor to protect it from the wash of waves, which are high with certain winds, and from the outfall a permanent concrete sea wall about 230 ft. long was immediately built, so as to serve as a cofferdam during the construction of the foundations. It is about 10 ft. high, 3 ft. wide at the top, and 5 ft. wide at the bottom, and is located on a ledge of rock, parallel to the shore line that extends along the whole front of the site, and being exposed at low tide, enabled the wall to be easily built in the open except in a few low places, where the water was readily excluded by small sand-bag dams.

A slip is to be built adjacent to the power house, and to protect its site with that of the power house, the sea wall was extended by a thin temporary concrete cofferdam wall 1 ft. thick at the top and 2 ft. thick at the base, which was reinforced by a fill of rammed earth on the back side. From the end of this wall the cofferdam was continued nearly at right angles for about 200 ft. by two rows of 3 in. sheet piles 16 ft. apart, braced together and filled between with puddled earth and clay. This part of the cofferdam is built in water about 10 ft. deep at low tide, and serves as a dock for the material barges. At the shore end it is continued about 100 ft. by a single line of sheet piles. A 4-ft. ditch was dug around the three land sides of the site about 900 ft. long, concave toward the river front, and intercepted all surface water and seepage through the sewer embankment, thus enclosing the area of the foundations and slip and some adjacent land, about three acres in all, and collecting the surface water so thoroughly that little trouble was experienced in draining the excavation. The ditch discharged into a sump about 10 ft. deep, located near the middle of the sheet-pile cofferdam. At this sump there were installed two direct-connected centrifugal pumps; one of them, having a 12-in. suction pipe, was made by the Greenfield Iron Works, Newark, N. J., and the other, with an 8-in. suction, was made by Morris Machine Works, Baldwinsville, N. Y. There was also a large marine pump there of unknown make, and there were three small Cameron plunger pumps for use in different parts of the excavation. Under ordinary conditions the pit was kept dry by the 12-in. pump alone, working at half capacity most of the time and raising the water a maximum height of about 15 ft.



Part of the Finished Foundations of the Port Morris Station.

Earth, mud and sand were excavated by pick and shovel, and, like the rock and hardpan, were put in side-dump cars, drawn by locomotives on surface tracks and dumped on the marsh or piled up within the limits of the site, the suitable material being saved for back fill. The excavation was carried down to a maximum depth of 38 ft. The spoil was handled to the dump-cars in 1-yd. steel buckets hoisted and traversed by three 350-ft. Cherry-Laurent traveling cableways, made by the Lambert Hoisting Engine Co. The cableways traveled on tracks parallel with the shore line, commanded the whole area of the site, and were also used to place the back fill and deposit the concrete.

The irregularities of the rock surface were leveled up with concrete forming a footing from 1 to 6 ft. thick, on which the piers, foundations and wall footings were built in simple moulds made with 2-in. dressed tongue and groove horizontal boards with vertical battens and corner pieces, tied together with ⅝ and ¾-in. horizontal screw rods, which were left permanently in the concrete when the moulds were removed at any convenient time after the concrete had set at least two days. No especial care was taken to make standard or regular panels for the sides of the moulds or to make them collapsible. They were nailed together at joints, but the boards were carefully separated when the concrete was stripped and were used over and over again. The intake and outlet tunnels for the condensation water have an oval cross-section about 10 ft. high and 7 ft. wide, which is symmetrical about its horizontal axis and is made with a heavy mass of concrete. The invert was first built around lagging nailed to transverse center frames like ordinary arch centers, and after it had set the centers were removed and reversed and supported on the invert to form falsework for the arch construction.

Supplies are delivered by barges to the cofferdam dock near the sump, where the boiler house is located, and the sand, coal and stone are unloaded by a clam-shell bucket operated by two stiff-leg derricks with 60-ft. booms, set on a tower. Storage is provided for about 200 tons of coal and for 2,500 bbl. of cement. The broken stone is delivered to two 200-yd. hopper-bottom storage bins in the top of the concrete tower, about 50 ft. above mean high tide. Between them is a 200-yd. sand storage bin with a coil of steam pipe in the lower part. It also has a horizontal smoke flue passing transversely through it and connected to the vertical branches from the boilers of the two Lidgerwood hoisting engines operating the derricks. This arrangement provides good draught, whatever may be the direction of the wind, and affords sufficient heat to prevent the sand from freezing in the coldest weather. After passing through the sand coil the exhaust steam from the hoisting engines is discharged into the 2,000-gal. water tank and maintains its contents at a temperature sometimes nearly at the boiling point.

Sand and broken stone are delivered through horizontal steel sliding gates in the hopper bottoms of the storage bins to two wooden hoppers on the measuring floor. These are filled and leveled to inside gauge marks and for a 24-ft. batch of concrete, five bags of Alpha Portland cement are added. The attendant for each hopper draws into a sunken barrel the requisite amount of water through a 2-in. pipe and hand valve from the hot-water tank and signals with two bells that all is ready. The mixer man on the floor below then revolves his mixer to the proper position, opens the upper door, pushes the wooden charging funnel on a horizontal track until it engages the mixer and hopper, and opens the hopper gate. When the hopper is emptied he closes the mixer door, throws the clutch into gear, and not until after the mixer is revolving does he admit the water through its hollow trunnion by opening a Penberthy injector. As soon as the required amount of water, indicated by a float with a vertical gauge rod in the water barrel, has been admitted, the water man, watching the gauge, signals the mixer man with one bell, and the latter closes the injector. The man above opens the supply valve and closes it when the barrel is filled to the required height and is ready for another batch.

The Smith concrete mixer, which consists of two truncated pyramids united at their bases, mounted on a horizontal axis through them, and having a hinged door at each apex, discharges after at least eighteen revolutions into a 1-yd. steel bucket on a surface-track car, which delivers it to one of the cableways from which it is dumped directly into the mould, or wherever else it is required. Each cableway has a nominal capacity of 300 buckets in 10 hours, but the maximum amount of concrete so far laid in 10 hours has been 300 yd., the average is about 125 yd., with a force of fourteen men in the concrete towers. In very cold weather salt is added to the concrete water in the proportion of 1 lb. to 18 gal., and a live steam pipe is connected to the trunnion of the mixing machine, outside the water connection, so that steam can be admitted to the mixer. By these means the concrete is delivered to the moulds at a temperature of about 90 degrees and, being immediately covered with tarpaulins in cold weather, is well protected against freezing.

Exposed surfaces of concrete are finished by rubbing smooth with wooden floats before the cement is set hard. All cement is accepted on samples tested at the chief engineer's office at 42d St. before shipments are made from the mills. Work was commenced May 16, 1905. Concreting was commenced for the bulkhead wall July 6, and for the main building Sept. 27; a force of about 300 men are now employed and the erection of the steel superstructure was commenced early in February. The work was designed and is being executed under the direction of the engineering department of the New York Central & Hudson River Railroad Co., Mr. W. J. Wilgus, fifth vice-president, Mr. H. Fernstrom chief engineer, Mr. Olaf Hoff, engineer of structures, Mr. W. F. Jordan, resident engineer. D. C. Weeks & Son, New York, are the contractors and Mr. Thomas Brennan is superintendent.

A SAND COFFERDAM was employed successfully in work at Burntisland Harbor, Scotland. A rubble sea-wall was first built by dumping stone from cars in the usual way. To make this wall serve as a cofferdam, the contractor for the works, Sir John Jackson, deposited sand along its back. This was pumped from a sand-bank into hopper barges, which dropped it into place behind the wall. Later this plan of working was changed. Sand was pumped from the sea bottom into steel barges which, when loaded, were towed to another sand-dredger moored outside the wall. An auxiliary pump on this dredger pumped a large quantity of water over the sand on the barges and the mixture was then delivered from the barges by the main centrifugal pump to its place behind the wall. The sand fill was about 70 ft. wide at the high-water level, and 220 ft. at a depth of 30 ft.

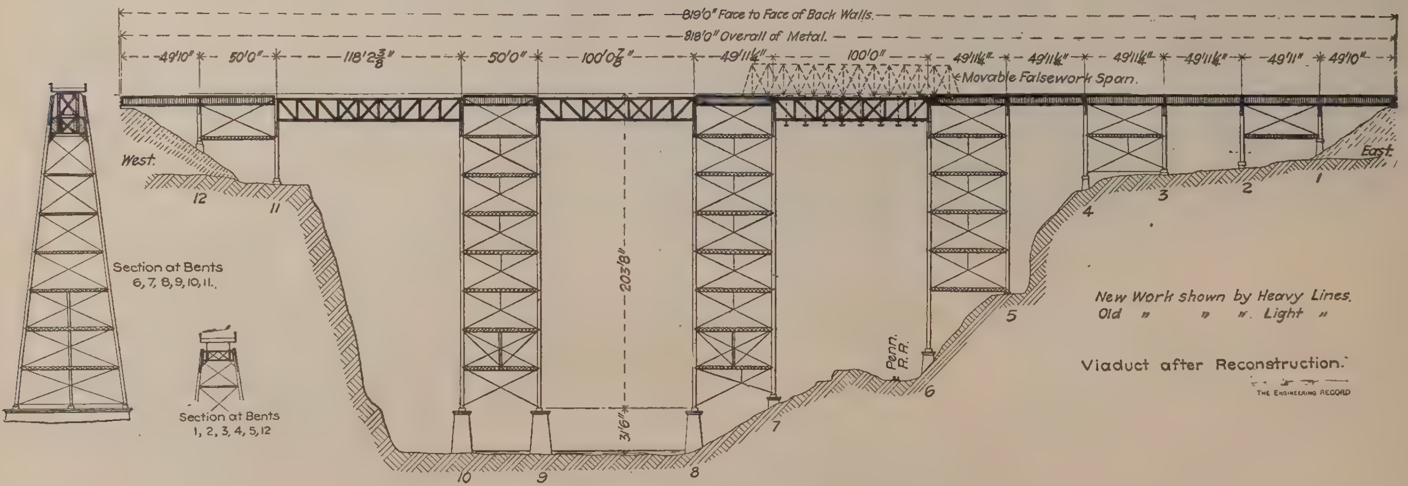
THE RECONSTRUCTION OF THE PORTAGE VIADUCT.

An Explanation of the Method of Reconstruction Without Interrupting Traffic.

The Portage viaduct is officially known as bridge No. 16 of the Buffalo Division of the Erie R. R. It is a single-track structure 819 ft. long and about 235 ft. high from the bottom of the river to the base of rail. It consists of six towers supporting plate-girder and truss spans of from about 50 to 118 ft. long. Originally it was built of timber, and for a long time after its completion in 1852, was famous for its height and imposing appearance where it crosses a rocky chasm a short distance above a beautiful waterfall. It was replaced in 1875 by a light pin-connected wrought-iron structure carrying a single track on long and deep ties laid across the top chords of the trusses, which were spaced about 20 ft. apart and were supported directly by the battered columns of the towers. It was originally intended to add at some time a second set of trusses close to the original ones, and from the four lines thus secured support a double track. This plan was never carried out, and when it became necessary to provide for heavier traffic, it was found feasible to support modern trusses and girders on the existing towers and masonry which were in good condition. New spans were, therefore, designed with special care to provide for their erection and the maintenance of traffic without interruption, and the reconstruction was successfully accomplished in 1903.

The new work was illustrated and its principal features were described in The Engineering Record of February 4, and consist essentially of 50-ft. deck plate-girders in the tops of the towers and between the shorter towers with two 100-ft. and one 118-ft. pin-connected deck Pratt truss spans between towers over the deepest part of the gorge. All of the spans are carried by new transverse girders riveted to the inner faces of the columns in the upper stories of the towers.

Tops of Old Towers with New Girders and Spans.



Viaduct after Reconstruction.

Reconstructed Portage Viaduct, Erection Traveler Shown Dotted.

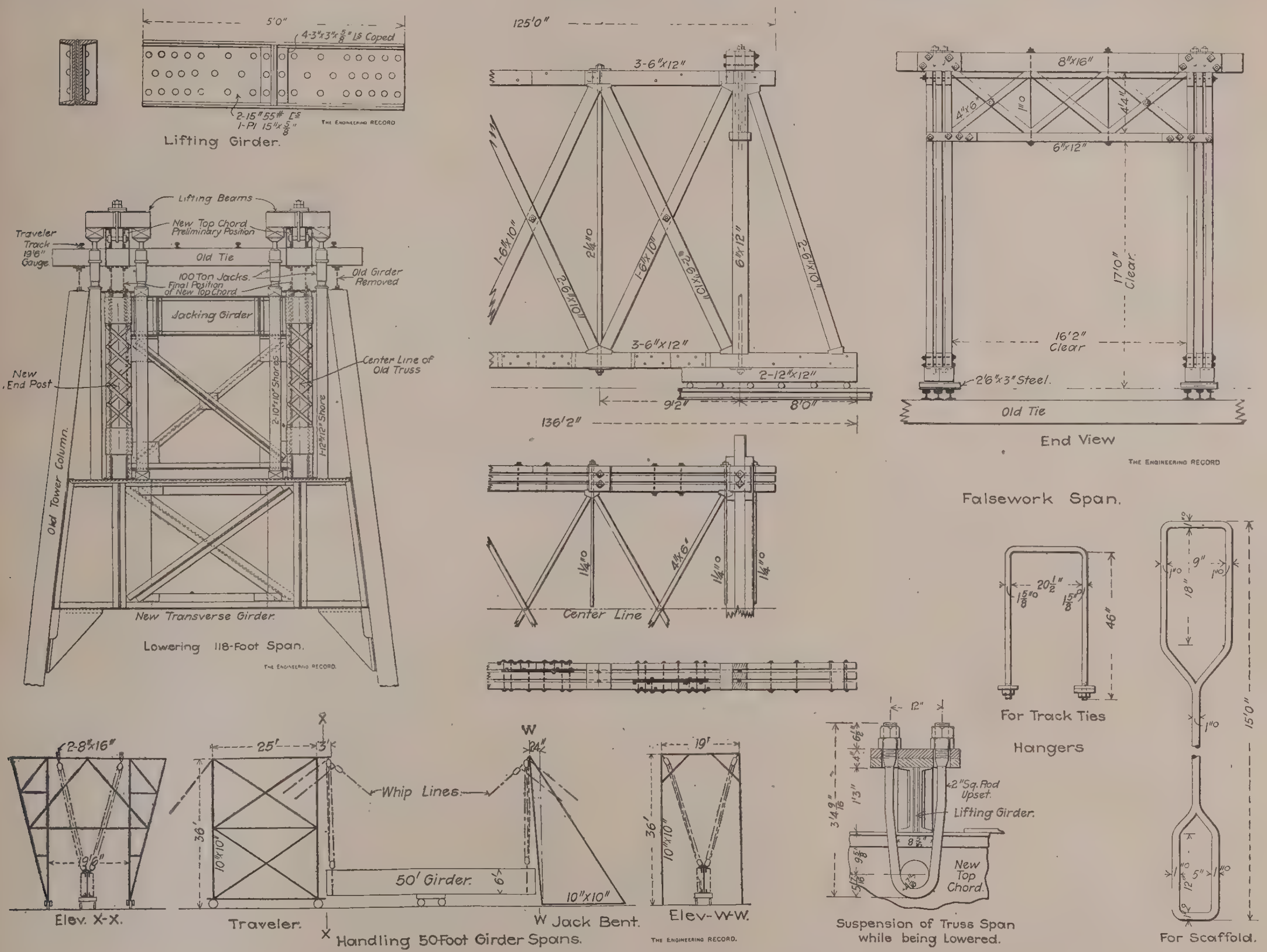
The old spans were all pin-connected trusses with their top chords seated on the column caps 19 ft. 10 in. apart on centers. In order to clear them, the new trusses and girders were made 14 ft. apart on centers, so as to have transverse clearance between the tower columns inside the old trusses. The panel points and transverse bracing were made different from those in the old spans, so that the members of the new structure would clear those of the old structure, as indicated by the accompanying diagram of one tower span and part of the 118-ft. span, which are typical of the whole viaduct. A general plan and elevation of the complete viaduct was published in The Engineering Record of February 4.

The sequence of operations and the details of the work were carefully determined in advance before the erection was commenced, and the erection was executed in exact conformity to these plans. The principal operations were connecting the new transverse girders to the tops of the tower columns; assembling on them the 50-ft. plate-girder spans and replacing the old track on them; assembling the truss spans above their required position on a platform suspended from falsework trusses; suspending the old track from the new trusses; removing the old trusses; lowering the new trusses to final position and laying the permanent track on them.

Operations were commenced by installing at the end of the viaduct an air compressor driven by a 22-h.p. Fairbanks-Morse gasoline engine. This was equipped with a receiving tank adjacent and an auxiliary tank in the middle of the viaduct, and distributed compressed air to all parts of the structure through a 1½-in. pipe with outlets about 50 ft. apart for flexible connections or manifolds.

Light working platforms in the tops of the towers were suspended from the track ties by 1-in. vertical rods with welded loops at both ends; and workmen on them cut away the lattice-bars on the inner sides of the battered posts and drilled holes for the connections of the new transverse girders. These holes were scribed from cast-iron templates through which the holes in the girders had previously been drilled. The holes in the columns, except in inaccessible positions where they were ratcheted by hand, were drilled by pneumatic tools manufactured by the Chicago Pneumatic Tool Co. There were about 2,200 holes 15/16-in. in diameter, and they were drilled at the rate of ten per hour by the pneumatic tools and four per hour by hand. While this work was in progress a 20-ton derrick was erected in the storage yard for unloading materials. It had a 42-ft. boom and was provided with one stiff-leg and two guys. With it the materials were piled up indiscriminately as received and sorted as delivered for use in the structure. A two-bent wooden gantry traveler was also built to run on rails laid outside of the track on the regular ties of the old bridge. It had sufficient clearance for the train traffic to pass through it, and it could be left in any position where it was required without interrupting trains. It was made with very deep overhead transverse bracing and had two cantilever jigger beams, from which tackles were suspended about 3 ft. clear of the front bent. The rear end of each jigger beam was anchored by a ¾-in. steel wire cable made fast to the old trusses.

The 10-ton transverse girders were delivered on trucks to the traveler, which lifted them by a single tackle hitched near one end of the girders and lowered them vertically between the ties of the old bridge floor. When they were clear underneath, a tackle from the other jigger beam was hitched to the opposite end of the girder and both tackles were operated to hoist the girder into a horizontal position and swing it to place between the tower columns, to which it was immediately connected by assembling bolts through all of the field-rivet holes. Riveting gangs closely followed the erectors and replaced the bolts by rivets, most of which were driven by pneumatic hammers. A girder was put in position and bolted up without obstructing the track more than about one hour, and the work was done at intervals between trains when it occasioned no interruption to traffic.



Apparatus for Lowering New Spans and Details of Travelers and Movable Falsework Span.

A sort of braced gallows-frame with longitudinal sills and inclined stiff-legs and having an overhang of 24 in. was built and equipped with two four-part Manila tackles corresponding to those on the traveler. This was called a jack-bent and was seated on one side of the tower, while the traveler was seated on the opposite side of the tower. A sufficient interval between trains was selected and the girders for the tower span were separately delivered and unloaded by the traveler and jack-bent main tackles which landed them alongside the track without releasing them from the tackles. The rails and cross-ties were removed from the old tower span by two whip lines attached to the traveler, and two attached to the jack bent, and were loaded on trucks and carried a short distance away. The top laterals and sway-bracing were then removed from the old span, leaving the bottom struts and laterals in position. The two new girders were then simultaneously lowered to their seats on the new transverse girders, their sway frames were bolted in place and their lateral rods were put in with the aid of the whip lines, which afterwards replaced the old ties and track on the new girders. The whole operation required about 2½ hr. from the time the old span was out of service until the new span was in service. Afterwards the old trusses and bottom lateral and transverse struts were removed piecemeal by the whip lines and the traveler and jack bent were advanced another span and so on. All of the tackles and the whip lines were operated by a two-drum-four-spool Lidgerwood hoisting engine located most of the time near the center of the viaduct, but occasionally moved for convenience.

While the 50-ft. spans were being erected, the falsework Howe trusses were framed in the storage yards, and after the 50-ft. spans were erected they were assembled on the cross-ties outside of the track at the west end of the viaduct. After they were braced together by the overhead struts which afforded clearance for trains to pass between them, each truss was seated on six solid steel rollers at each end and rolled forward on tracks made with three lines of rails spiked to the old ties. The trusses were first moved over the 118-ft. span and wedged up at the ends to release the rollers and take bearing over the tops of the tower posts. Thus there was no extra dead load on the old light spans on account of erection. Vertical suspenders were then attached to the lower chords of the trusses and transverse I-beams were connected to them just above the lower chords of the old viaduct trusses.

On them was laid a working platform and the lower chords of the new trusses were assembled on it, supported in the usual manner by blocking and camber wedges. The vertical and diagonal members of the trusses were then put in position and connected to the lower chords, and finally the top-chord pieces were set on the vertical posts completing the trusses. The pins were driven and the trusses were swung from blocking over the new transverse girders, which raised them about 3 ft. above their final position. All of the bracing except the top laterals was connected to the trusses and the working platform was removed, the suspenders extended and the platform replaced below the lower chords of the old trusses, where it served to support them during their removal. Before the old trusses were removed, the 8x16-in. cross-ties 22 ft. long, which had rested on their top chords, were suspended from the new top chords which just cleared them, by pairs of U-bolts, and the spans being thus shortened, their strength was increased to carry the traffic from the new trusses and release the old trusses. After the old trusses were removed, transverse lifting girders were connected to the ends of the new trusses by U-bolts engaging the end top-chord pins and passing between the chord webs where short sections of the cover-plate had been temporarily omitted to give them clearance. The girders were short enough to clear trains on the main track, and were supported at each end clear of the new trusses by 100-ton hydraulic jacks. The two inside jacks were theoretically carried by the plate-girder connecting the tops of the end posts of the new trusses, which were erected independently of the trusses and were braced together so as to virtually form temporary tower bents. The top flanges of the jacking girders were thought to afford too narrow bases for the jacks and 10x10-in. vertical shores were therefore set under the jacks on both sides of the girder to prevent any danger of tipping or displacement and transmit any eccentric load directly to the main transverse girders. Single 12x12-in. vertical shores at the ends of the transverse girders supported the jacks under the outer ends of the lifting girders. By these eight jacks the span was lifted slightly to release the blocking which had supported its top chords on the new transverse girders, and was then gradually lowered to its final position with the ends of the top chords seated on the cap plates of the vertical end posts.

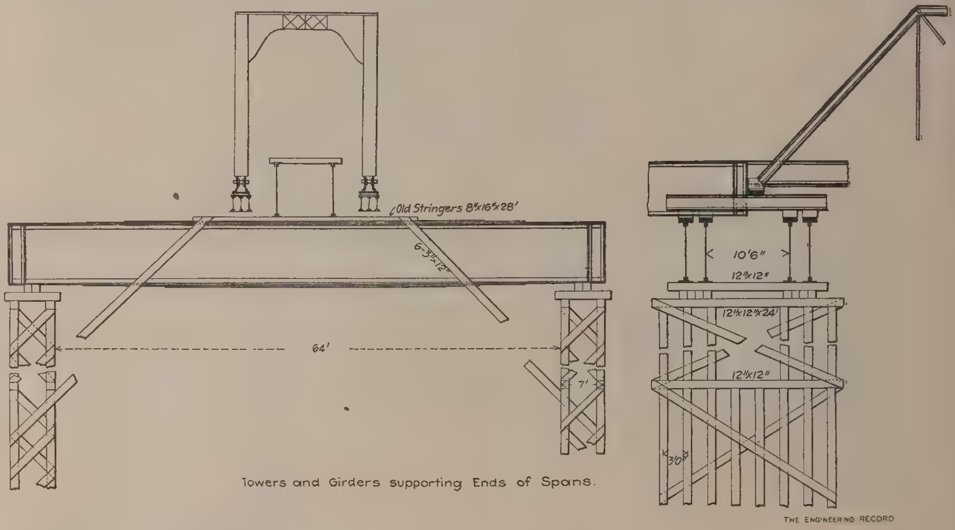
The total displacement was about 3 ft. and the rails were blocked up to maintain the original elevation as the trusses descended. After they had been lowered about 15 in., temporary ties and stringers were connected to them providing for the heaviest traffic, while the original ties were removed and the truss lowering was completed at convenience during intervals between trains, care being taken, of course, to always provide blocking to support the truss in case of any failure of the jacks. When the old ties were removed, the top-lateral system was assembled and the field rivets were driven as soon as possible after connections were made. One new span was put in, riveted up complete and the old span removed in 15 days. The entire work of reconstruction was done by an average party of sixteen men, who were employed for a total period of eleven months, although less than seven months were required to put the new spans in service; but a long time was necessary to complete the bracing in the readjusted upper panels of the towers, to cut off the upper ends of part of the tower columns and to finish various tedious operations. A 6-in. water main in service was carried on the bridge, and its maintenance during the renewal work was rather troublesome. Work was commenced May 25, 1903, and all of the new spans were in service Dec. 15, 1903.

The work was concluded without accident and at a cost materially less than the original estimate. The work was designed and the erection methods planned by Mr. Mason R. Strong, engineer of bridges under the direction of Mr. C. W. Buchholz, then chief engineer of the Erie R. R., and his successor, Mr. W. L. Derr. The 500 tons of steel work were built by the McClintic-Marshall Bridge Co., and were erected by the railroad company's regular erection force in charge of Mr. W. H. Wilkinson, inspector of bridges.

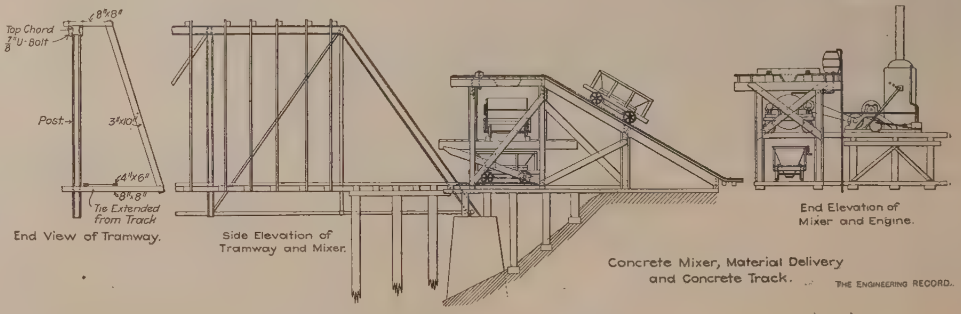
An Unusual Pier Foundation was prepared some years ago by Sir Guilford Molesworth for a Ceylon bridge. The rock bottom was about 8 ft. below the water surface. He made a small islet of broken rock on this bottom and carried it up about a foot over the water line. The upper surface was then pounded with a heavy ram, after which a shallow pit was excavated in its center. Grout was filled into this pit and penetrated all the interstices of the heap of stone, consolidating it effectively.

Reconstructing Piers of a Railroad Bridge in Service.

A rather unusual piece of substructure work has recently been successfully accomplished in replacing two piers and repairing one abutment of a railroad bridge under traffic where exceptional difficulties were encountered. The bottom of the river was very much obstructed, the river was subject to sudden high floods and to dangerous ice gorges, and one new pier had to be built in the same position as the old one. The work was executed with ordinary plant and involved interesting features in the method of supporting the spans over the replaced pier, and novel devices for supporting the service track, driving the concrete mixer, and handling concrete buckets where there was not sufficient clearance to operate a derrick.



Towers and Girders supporting Ends of Spans.



End View of Tramway.

Side Elevation of Tramway and Mixer.

End Elevation of Mixer and Engine.

Concrete Mixer, Material Delivery and Concrete Track.

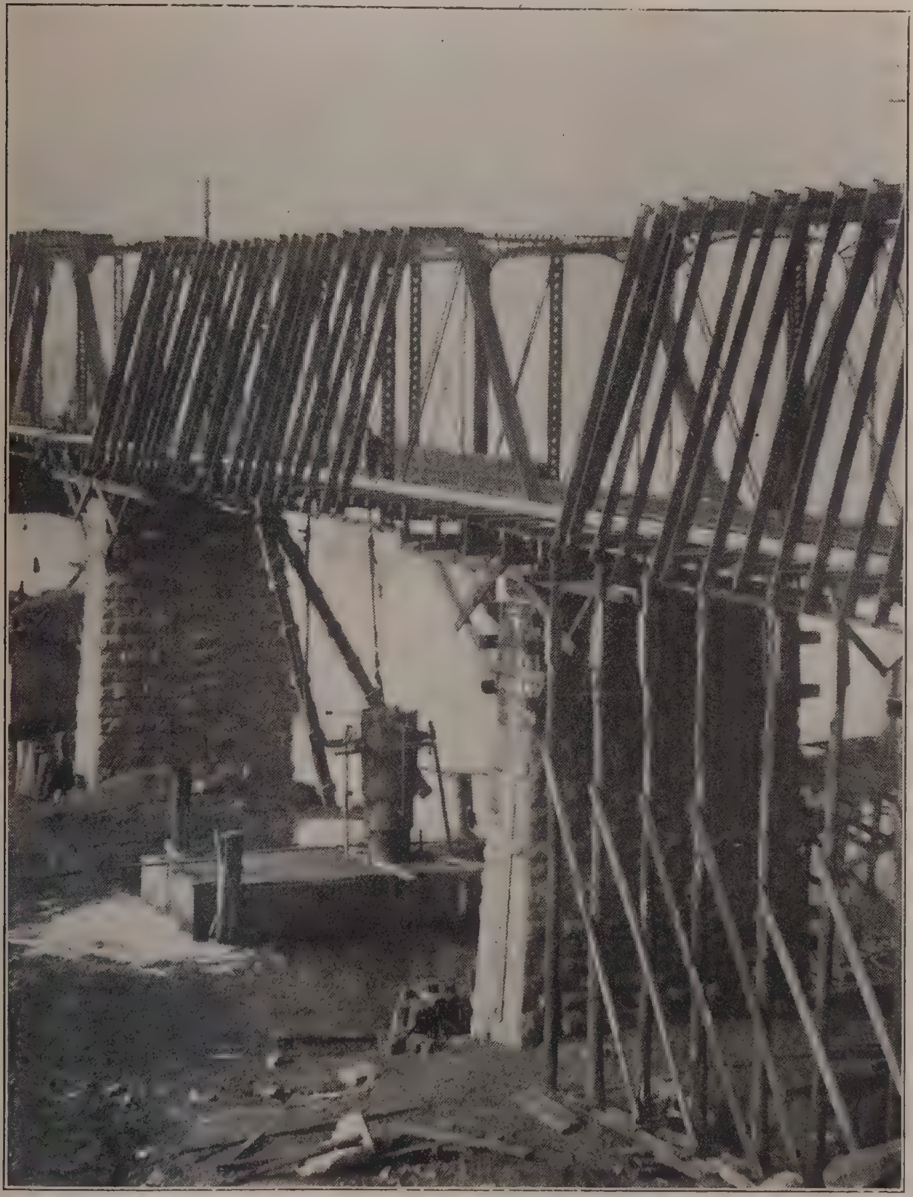
Temporary Erection Structures.

The Wabash River bridge, of the Cleveland, Cincinnati, Chicago & St. Louis Ry., at Terre Haute, Ind., consisted of one curved-chord, 230-ft. span, one 78-ft. girder span, and three 125-ft. Pratt truss spans, resting on limestone masonry piers. From the base of rail to low water is about 40 ft. The old piers were built in 1865, when the road was constructed. They were 22 ft. in length by 6 ft. in width under the coping, and were square ended, with a batter on both ends and sides of ½ in. to a foot. There seems to be no record of the foundations of these piers, but they were supposed to rest simply on timber grillage some distance below low water. The three 125-ft. spans were on the east side of the river and were very much too light for the increased weight of the heavy rolling stock of the Big Four System. It was first decided to replace the three spans with five 74-ft. girders supported on four new concrete piers.

An attempt was made early last spring to build a pier by the open cofferdam process, but after working at it for some months it was found, on account of the quantity of rip-rap stone in the river that this process was practically impossible. The contractor made several attempts to drive sheet piling, and finally did succeed in getting in what appeared to be a fairly tight sheet pile cofferdam, but when he undertook to pump the water out he found that he could not lower it more than a fraction of an inch with one 10-in. and one 6-in. centrifugal pumps. On further investigation it was found that the whole river bottom was filled with rip-rap of sizes running from one-man stones up to 3-ton stones, and, in addition to this, there were two old bridge spans, a locomotive and 40 old freight cars, the remnants of three wrecks on the bridge, besides old falsework piles that had been cut off below low water.

On account of so much debris in the river, and also because the range between high and low water in the Wabash at this point is about 27 ft., and the ice gorges in the spring are very severe, the first plan for replacing the three east spans was abandoned and it was decided to put in two piers resting on pneumatic caisson foundations and two 184-ft. Warren truss spans, thus giving a greater waterway between the piers, and less chance for the ice to gorge than by the other plan.

The Foundation Company, 35 Nassau St., New York, was called in consultation and given a contract to construct these new piers and rebuild the east abutment. They designed the caissons, which were approved by the chief engineer. The caissons were built of 12x12-in. yellow-pine timber, the walls being 24 in. thick and the deck 36 in. thick, with a 4-in. oak shoe on the cutting edge. They were 38 ft. 6 in. in length by 16 ft. 6 in. in width, with a working chamber 6 ft. 4 in. high, with 35 ft. of 12x12-in. beech cribbing on the deck, in which 1:2½:5 concrete was deposited during the process of sinking the caisson. The first caisson was built on shore about 200 ft. below the bridge. Owing to the shallowness of the water in the river it was found necessary to build a false bottom on it in order to successfully launch it. The caisson was launched Oct. 22, 1904, and was towed to the site of the new pier the same day. The bottom of the river at this point had been found to be very uneven and had been leveled off previously with an orange-peel dredge bucket. The caisson was equipped with four 4-in. pipes used as blow pipes, air-supply pipe, and water-jet pipe, besides one 4-ft. combination shaft used with the Moran lock. Air pressure was applied to this caisson Oct. 31, after enough concreting had been done in the crib to sink and land it. The false bottom was then removed and it was found that the deck of the caisson rested on three 16x16-in. square piles, evidently part of old falsework.



Delivering Concrete through Chutes from Material Track to Caisson.

The first material excavated was cinders, which extended to a depth of 4 ft. Under the cinders came rip-rap stone, which extended down to a depth of over 30 ft. This was all taken out by bucket. About 15 ft. down an old 30-in. steel floorbeam 16 ft. long was encountered that ran diagonally across the northeast end of the caisson. This was cut off in short lengths with a diamond point chisel and removed through the lock.

The piles extended down to a depth of 35 ft. and had to be cut off about every 3 ft. Four logs from 16 to 36 in. diameter were encountered in sinking this caisson, and in all cases extended under the shoe of the caisson, making it slow and difficult work to cut them out, which was done with chisel bars and hammers. The remains of an old caboose were also found with truss rods, etc., extending out under the shoe, all of which had to be cut off. Below the rip-rap stone was found sand and gravel, which was disposed of through the blow pipes.

The caisson was finally landed at a depth of 45 ft. below low water, just four weeks from the day it was launched. The new pier on this caisson is of concrete extending from 2 ft. below low water to 40 ft. high under the coping. This pier is 30 ft. 2 in. by 10 ft. 4 in. on the bottom and has semi-circular ends and a batter of 1:24 on both sides and ends. The coping projects 6 in. over the sides of the pier and is 2 ft. thick.

On account of the steepness and height of the river banks and cramped yard room, the handling of material was a difficult problem. A temporary pile trestle or tramway could have been built from the bank out to the pier, but on account of the sudden high floods feared it was considered a thing to be avoided if possible. To ease matters in this direction a service track was built on the south side of the bridge, and was supported on 8x8-in. transverse timbers, running between the ties and under the rails of the bridge. The outer ends were bolted to 3x10 in. inclined suspension timbers bolted at the top to short 8x8-in. pieces set on the top chords of the trusses and secured to them with ⅞-in. U bolts. This arrangement could not be used at the ends of the spans adjacent to the inclined end posts where the outer ends of the transverse timbers were carried on the top chords of wooden deck trusses seated on 12x12-in. blocks bolted to the piers. Concrete was carried along this track from the mixer in bottom-dump 3-ft. gauge cars, which discharged it at points over the piers, into chutes which led to the crib or concrete forms, thus obviating the necessity of handling any concrete with a derrick. A derrick was erected at the north and upstream end of the first pier to handle the timber, sections of air shafts, etc., and was supported on a pile platform.

The Olsen cubical concrete mixer was arranged to discharge directly into the dump cars. The concrete material was shoveled into other dump cars and pulled up an inclined track so as to discharge over and into the mixer. The mixer was run by a 7½x10-in. Lidgerwood hoisting engine by means of an endless chain engaging a sprocket gear on the shaft of the engine in place of the nigger head. This engine was used also to pull the cars up the incline to the mixer.

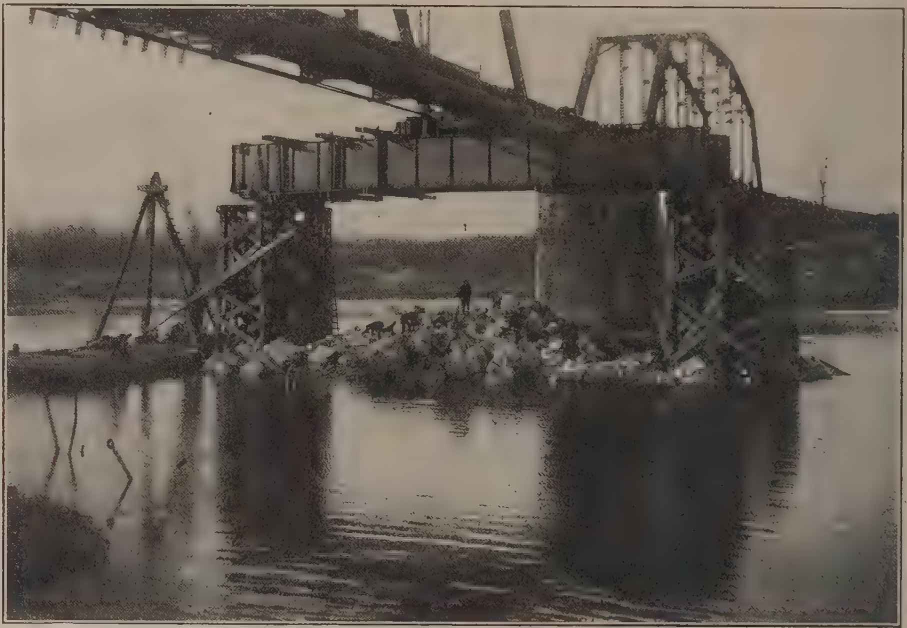
The site of the second caisson was the same as one of the old piers, on which rested one 125-ft. truss span and a 74-ft. girder span. It was necessary, therefore, to support these two spans while the old pier was being removed and the new pier built and not delay traffic, which was very heavy on account of the World's Fair at St. Louis. It was impossible to build ordinary falsework under the old spans which would support them and still give room to sink the caisson. Towers were therefore built 32 ft out from the track on the upstream and downstream sides of the bridge, and consisted of two bents 7 ft. center to center, each with eight 40-ft. piles driven to a penetration of 25 ft. On these bents were seated monkey bents made of six 12x12-in. posts, 13 ft. long, capped with 12x12-in. transverse timbers and a solid 12x12-in. longitudinal course. Both pile and trestle bents were strongly braced longitudinally and transversely. Four 74-ft. plate-girders transverse to the track were supported on these towers, two on each side of the old pier. The girder span of the bridge rested directly on two of these cross-girders. Each shoe of the 125-ft. span rested on three 24-in. iron stringers, supported by the other pair of girders.

The old pier was surrounded by rip-rap and piles which had a penetration of about 24 ft. It was necessary to pull thirty-six of these piles in order to make room for the caisson. This was done with difficulty by large hydraulic jacks and chains having links 1¼ in. in diameter, which were continually breaking.

After the spans took bearing on the new falsework, the old pier was torn down, leaving the girder and truss spans supported only by the towers and cross-girders. The cross-girders weighed 18 tons each and were lowered and set in place with an 80-ton wrecking derrick belonging to the railroad company. They were brought down from the yard, where they were stored, hanging on the boom of the wrecking derrick, which balanced them from a chain lashing in the center of the girder. When the derrick was at the pier site it was moored to the bridge and the boom was slewed enough to let the girder clear the bridge. It was then lowered to the ground below and a new hitch taken on it through the center of the track, and it was raised, turned at right angles with the track and seated on the towers. The placing of these girders occupied four days' time.

When the old pier was removed to low water it was found that it rested on two courses of timber grillage at right angles to each other and supported on sixty piles 28 ft. long. This caisson was built directly over the place where it was to be sunk and was supported during construction on four needle beams hung from special falsework by eight long 3-in. iron screws. After the caisson was completed it was lowered into place and the needle beams chopped out after air was turned on. The work of excavating in this caisson was very tedious, on account of the difficulty of removing old longitudinal and transverse timbers (probably used for bracing a cofferdam at the time the foundation piles were driven), quantities of rip-rap, several large logs and the sixty piles, one row of twelve piles being directly under the cutting edge. The stone and cribbing were taken out by means of a bucket. The interior piles were sawed off from time to time as the caisson descended, but those under the cutting edge had to be chopped off with chisel bars. One cottonwood log 4 ft. in diameter was encountered about 20 ft. below the bed of the river and extended the entire length of the caisson and under the upstream and downstream cutting edges.

Owing to the limited head room above the lock on this caisson, there was no room for a derrick to be worked, so a cableway was installed running from the cross-girders over to the next pier, and was used to handle the bucket, air shafts, etc. In spite of the difficulties encountered this pier was sunk at an average rate of nearly 15 in. a day, and was located exactly in the required position. The pier masonry was started several feet above where the caisson was landed in order to get weight enough to overcome the skin friction. In neither case has it been found necessary to change the form any after the caisson was landed.



Falsework Towers and Girders Carrying Spans over Debris of Old Pier.

Material Track Suspended from Trusses and Supported on Pier Truss.

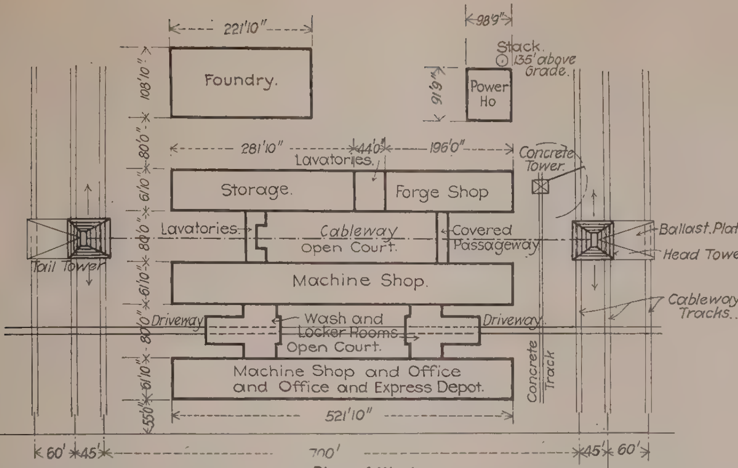
The old east abutment of the bridge was of stone similar to that used in the piers, built wide under the track and gradually sloping in at the bottom to a width of 9 ft. The bridge seat was 21 ft. long and 5 ft. wide. The footing extended to a depth of about 15 ft. below the bridge seat and rested on one course of timber grillage. On examination this was found to be badly decayed. The ground under the timber was excavated in small sections to a depth of 4 ft. 6 in. and 3 ft. back from the front edge. The decayed timber was removed, the excavation filled with concrete, a 2-ft. concrete facing built on the front of the old abutment masonry, and new concrete wing walls at right angles to it, thus making practically a new U-shape abutment. The concrete comes up flush with the old masonry in front; on the sides, however, a space was left between the old and new masonry and filled with dirt, well tamped. Drainage pipes extend from this earth chamber through the concrete to the front of the abutment at the surface of the ground.

All through this work it was the endeavor of the contractors to keep as much temporary work out of the river as was possible. On account of the danger of sudden floods, the air pipe was carried out on the old bridge, and a 4-in. hose run down at each pier and connected with the caisson pipe there. The service track was on the same level as the bridge proper. A trestle was arranged on top of one of the old piers to support a hoisting engine, used to operate the bucket in the caisson, so none of the plant was exposed to the dangers of flood and delays in the work could not occur during any ordinary high water from that cause.

Mr. C. W. Kittredge is the chief engineer of the C., C., C. & St. L. Ry. Co., and Mr. C. B. Clark is the assistant engineer, under whose personal supervision the girders supporting the ends of the spans over the replaced pier were put in place. Mr. B. H. Miller was the resident engineer in direct charge of the work. Mr. George W. Adgate was the western manager, and Mr. Fred W. Adgate was the superintendent in charge of the work for the Foundation Company.

Grouting Dam Foundations.

Grouting the foundations of the barrages at the head of the Nile Delta was made necessary years ago by the undermining of a portion of the structures, but the operations were not carried out until a few years ago. The work was done by sinking five holes along the center line of each of the ordinary piers between the shutters and double rows of holes on the three central piers of each of the dams. The ordinary piers are 6 ft. 7 in. wide and the openings between them are 16 ft. 5 in. wide; this made the holes in one pier about 23 ft. from those in the adjacent piers on either side. The holes were 5 in. in diameter and there were 774 of them sunk. The piers rest on sand except where a rubble filling was thrown in as a rough platform to build upon. Each hole was carried down at least 3 ft. below the bottom of the masonry. The Portland cement grout was made with only enough water to cause it to flow readily, and in three cases it was found that under the head of 1.7 to 2.4 tons per square foot due to the elevation of the top of the bore holes above the water level, the grout traveled from one pier to the next. This work required 6,094 barrels of cement and cost about $30,000. It was noticed that the grout apparently expelled by its own weight any excess of water which had been added to the cement and acquired thereby the desired specific gravity of two. The plan of grouting in this way was found to be particularly adapted to the character of the labor available in Egypt, which was not sufficiently skilled to render usual methods practicable.

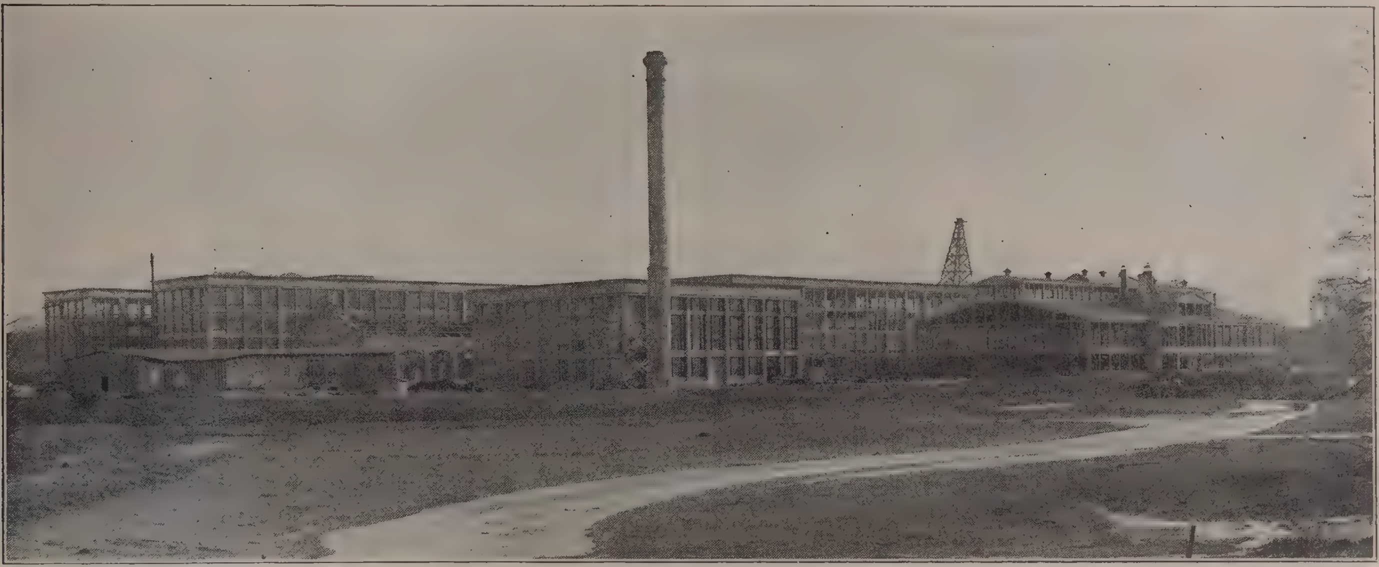


Plan of Works.

THE CONSTRUCTION OF THE STEEL-CONCRETE SHOPS AT BEVERLY, MASS.

Buildings for the New Plant of the United Shoe Machinery Co.

The buildings for the new plant of the United Shoe Machinery Co., Boston, at Beverly, Mass., occupy a large portion of an area over 500 ft. square and comprise three structures about 62 ft. wide by 522 ft. long, which nearly everywhere have a total height of about 62 ft., including four stories and basement. These buildings are connected by intermediate structures, and there are also two other large rectangular buildings about 210x120 and 110x96 ft., as shown in the block plan. One of the latter two has steel girders and trusses in the roofs. With this exception, all of the buildings are made entirely with concrete reinforced by twisted steel bars of the Ransome system.



General View of Nearly Completed Main Buildings.

The site is on low and comparatively level ground near the Bass River, and a large amount of filling and grading was done on it before building operations were commenced. In the power house and in part of the foundry the wall footings were carried down considerably below grade to the level of the column foundations and were made entirely of concrete like that in the upper part of the building. Above the first-floor level the walls of the three main buildings contain scarcely any concrete except the columns and narrow belt courses at the floor levels, the wide spaces between being almost entirely filled with glass. In the foundry and power house there is a little more plain concrete wall surface, but a large part of the area is glazed in these buildings also.

In the main buildings the principal methods of construction were devised for building the columns of each story first, then the floor for the succeeding story, its columns, and so on; the belt courses in the walls being made simultaneously and integral with the corresponding floors. In the foundry, power house and connecting buildings the concrete walls were carried up simultaneously with the columns. In each of the two duplicate main buildings the fifty-four interior columns are about 20 ft. apart and have octagonal cross-sections varying in diameter from 8 in. at the roof to 22 in. at the first floor. They are seated on offset rectangular bases 6 ft. square, and about 5 ft. below the first-floor surface. Each column is reinforced with eight ¼-in. vertical bars made continuous from base to top by lapped splices just above each floor level. Each column is also reinforced by a helix of ⅛x½-in. steel rod with a 4-in. pitch tangent to the inner sides of the vertical rods.

The moulds for these columns were made of vertical 4x1⅛-in. sheathing boards in single-story lengths mitered together with close joints at the angles of the column. Each face of the mould was made with two boards joined on the center line. The edge of one board was planed square and the other slightly beveled so as to make a V-shape joint closed on the inner side and open on the outer side to allow for the swelling of the wood by the moisture in the concrete. The vertical boards were nailed to horizontal rectangular cross-frames about 3½ ft. apart vertically. Each frame was made with a pair of transverse and a pair of longitudinal yokes and tie-bolts. The 3x6-in. yoke pieces had triangular blocks nailed to the inner edges at both ends to receive the corner pieces of the moulds. The tie rods were fitted with bearing washers and nuts at both ends and engaged slots in the yoke pieces, so that as soon as the nuts were slackened the rods could be quickly removed. The reinforcement steel was carefully secured in the moulds and the latter were filled with concrete, the lower portion of which was compacted by the fall of several feet from the top of the mould and the upper portion was thoroughly rammed and spaded.

The wall columns in the main building have approximately rectangular cross-sections made slightly T-shape by the extensions on the sides for the window casing. They are reinforced by vertical and horizontal rods, the latter forming separate rectangular frames about 2 ft. apart vertically. In the ends of the main buildings the wall columns have solid cross-sections, but in the sides they are made hollow with center rectangular openings lined with brick and designed to serve as hot-air flues. They were made in moulds similar to those used for the interior columns.

In all cases the column moulds serve also as falsework posts to help carry the centering and moulds on which the floor slab, beams and girders were laid. These consisted virtually of bottomless boxes made with outer dimensions exactly conforming to the clear distances between the beams and girders. They were spaced concentric with the floor panels with the upper surface in the plane of the lower surface of the floor slab. Their ends and sides thus formed the vertical sides of moulds for the floorbeams and girders, the bottoms of these moulds being made by horizontal strips fitted between the adjacent boxes. The boxes were supported on their lower edges by the column moulds and on intermediate supports under the beams, as indicated in the detail cross-section.

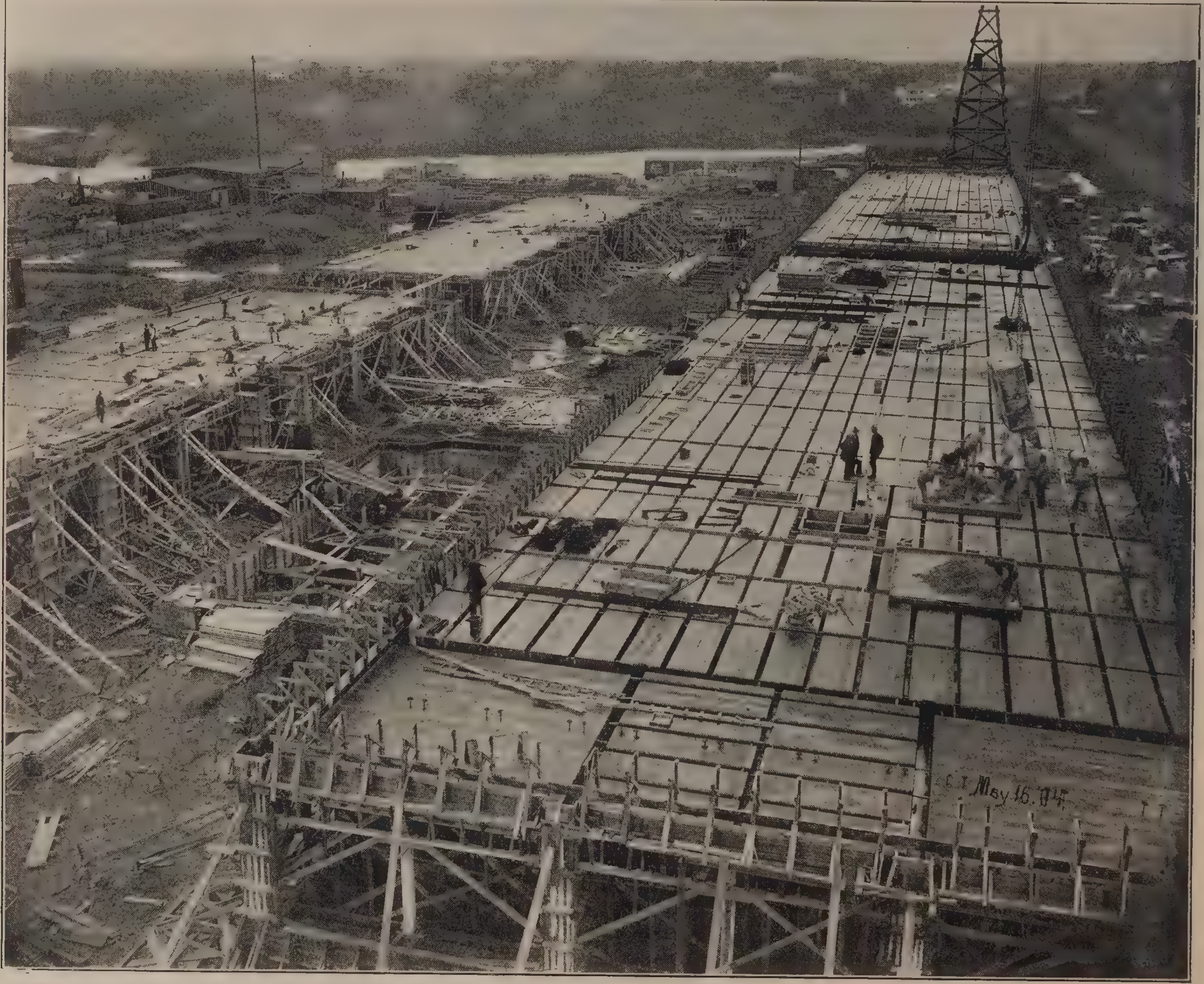
The upper sides of the boxes were formed with 5x1¼-in. boards laid lengthwise, battened together on the under side and supported on cross strips 3 ft. apart. The lower edges of the troughs were stayed by transverse strips 3 ft. apart. The upper edges were all rounded to a 2-in. radius, and small fillets were placed in the lower angles of the beam and girder moulds to prevent sharp corners in the concrete.

The joints between the sheathing boards were made slightly open on the outside, like those in the columns, to provide for the swelling of the wood. By this system the floor moulds were made with a very large number of interchangeable duplicate units of such size that they could be easily and quickly handled and readily fitted together to conform with any arrangement of beams and girders, the latter being designed with uniform clearance between them so that the same boxes could be used for beams and girders of different widths.

Enough moulds were provided for the simultaneous construction of a ground floor in two of the three main buildings, and of the second and third floors and roof in one main building. They were all put in place and concreting was commenced at each end of a building and carried through to the expansion joint in the center. The reinforcement bars were blocked up to the proper positions in the beam and girder moulds and over the floor, and were secured to prevent their displacement during concreting. The concrete was then shoveled into the moulds and into position on top of them to the required thickness of the floor slab and was thoroughly rammed and rolled. Contraction joints occurred every 60 ft. in the floors, and the day or night work was suspended at these points. Where these joints occurred, they were formed by double 3x12-in. bridging beams, with leather board or zinc between, so that the joint with the succeeding work would not weaken the construction. After the concrete at one end of the floor was about fourteen days old, the moulds for the columns, beams, girders and floor could be removed and the carpenter force could make necessary repairs and set them up ready for use in the second story. The intermediate supports under the beams and girders were generally replaced and allowed to remain for seven days after the floor boxes had been removed and the columns had been stripped. This was done to avoid possibility of danger by prematurely applying full loads to the wet concrete beams.

The roof was built in the same manner as the floors, and the first or ground floor was supported in most cases on the rolled earth at grade. This floor consisted of a 4-in. bottom layer of concrete covered with waterproofing flashed up a few inches on the side walls and then finished with a 6-in. layer of concrete troweled smooth on the upper surface. The dimensions of the floorbeams and slabs vary, but in general a 20-ft. panel has six 5x15-in. longitudinal beams 20 ft. long reinforced by three ¾-in. tension bars in the lower edge. These beams are supported by two 12x27-in. transverse girders reinforced by four 1-in. tension bars in the lower edge and two ¾-in. compression bars in the upper edge. They carry a 3-in. floor slab reinforced with a layer of ¼-in. bars 12 in. apart and proportioned for a load of 200 lb. per square foot.

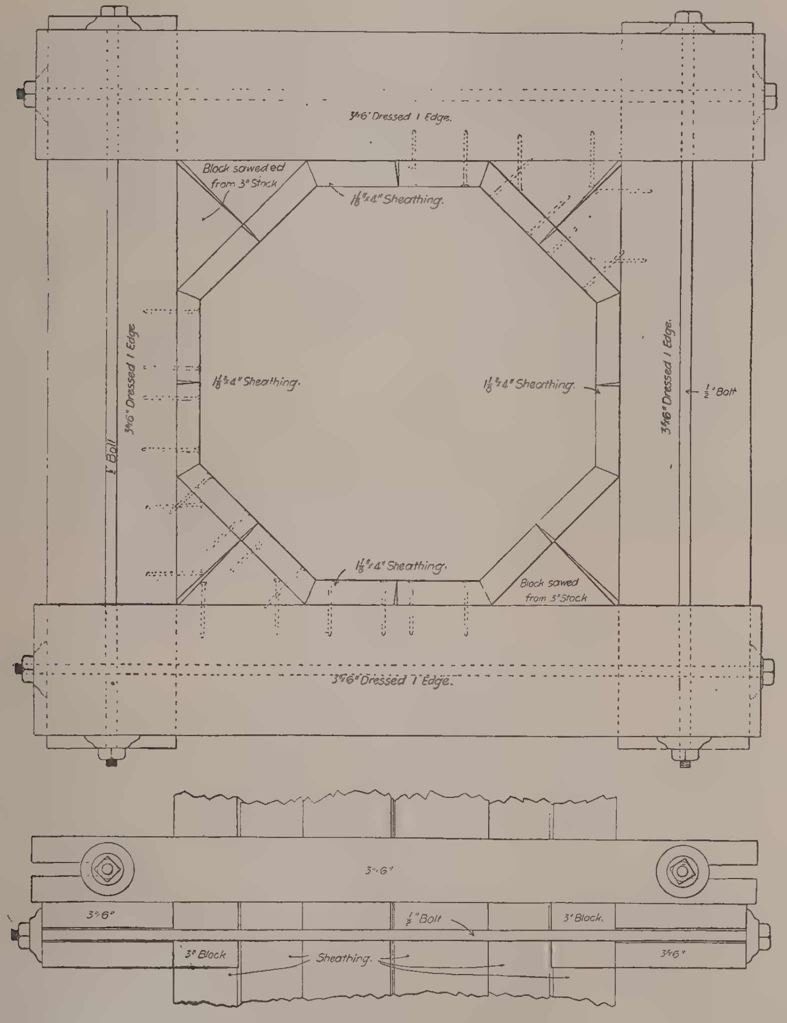
The belt course between the first and second stories is made hollow with thin walls reinforced by horizontal bars in each corner. The belt courses above the second floor are made solid and are reinforced with horizontal bars in each corner to give them sufficient strength to act as long beams. They form the window caps and sills and are integral with the floor slabs. They were made in moulds built up with horizontal boards and braced by yokes having vertical strips projecting above the upper edges of the moulds and braced together there. They were also kneebraced at the bottom to horizontal projections of the falsework, and all of the column moulds were thoroughly braced by diagonal struts in the different stories and on the exterior, the latter, in the first story only, being secured at the lower ends by stakes driven in the ground. All moulds were



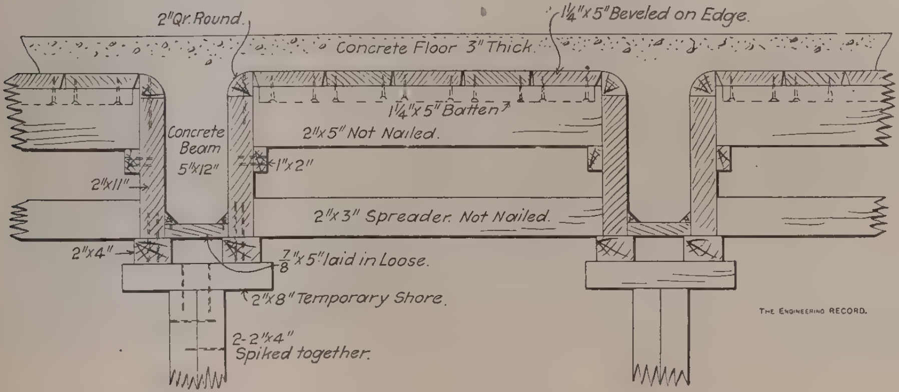
Concreting Second Floor of Main Buildings, United Shoe Machinery Co., Beverly.

braced entirely from the inside, no through bolts or steel ties being used.

The concrete construction was commenced in the fall of 1903 and had reached to the first floor of one main building when the weather became severely cold in the winter of 1903-4. A framework was then built over the last completed floor, enclosed with canvas, and fires in open braziers were kept burning night and day to raise the temperature inside sufficiently for the concreting to be carried on. This was done at a reduced speed. The concrete materials were warmed before mixing, salt was used in the water, and as fast as the concrete was laid the exposed surfaces were covered with canvas. These precautions enabled the work to be carried on during the winter, and the appearance and strength of that portion of it are unimpaired, as demonstrated by a test load of 450 lb. per square foot, which was sustained without injury. The finished exterior walls are dressed with pneumatic hammers to resemble cut-stone masonry, the effect being very satisfactory to the contractors and architect. Elsewhere the walls are left with the smooth finish imparted by the moulds and the imprint of the joints between the boards and of the grain of the wood give it a striking resemblance to heavy timber construction. The concrete surfaces in the interior of the building are painted white, which, with the ample window space, secures an unusually good illumination.



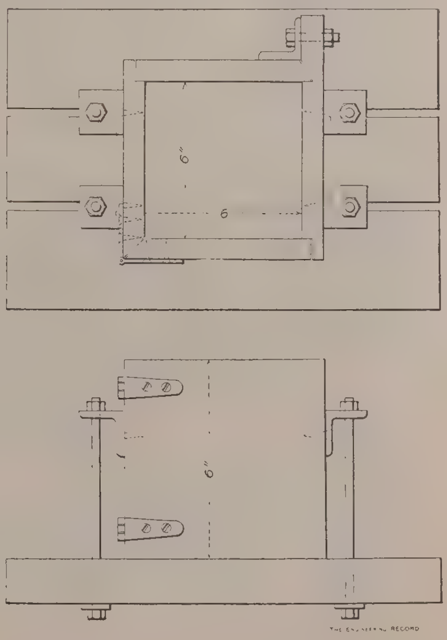
Mould for Columns.



Mould for Floorbeams.

The 1:2:5 concrete for the columns and walls and the 1:2:4 concrete for the beams, girders and floor slabs is mixed very wet with Portland cement of the Lehigh and Atlas brands, and is made with screened gravel from ¼ to 1 in. in diameter. In cold weather the concrete was mixed with water to which there had been added for every cubic yard of concrete 2 qt. of a saturated solution of common salt. The square steel bars used for reinforcing the concrete were received from the mills in commercial lengths of from 22 to 30 ft., and were twisted by machines installed at the site. After they were twisted they were cleaned just before they were put in the concrete by being immersed in a long wooden box filled with a one-eighth solution of sulphuric acid, after which they were thoroughly washed in running water.

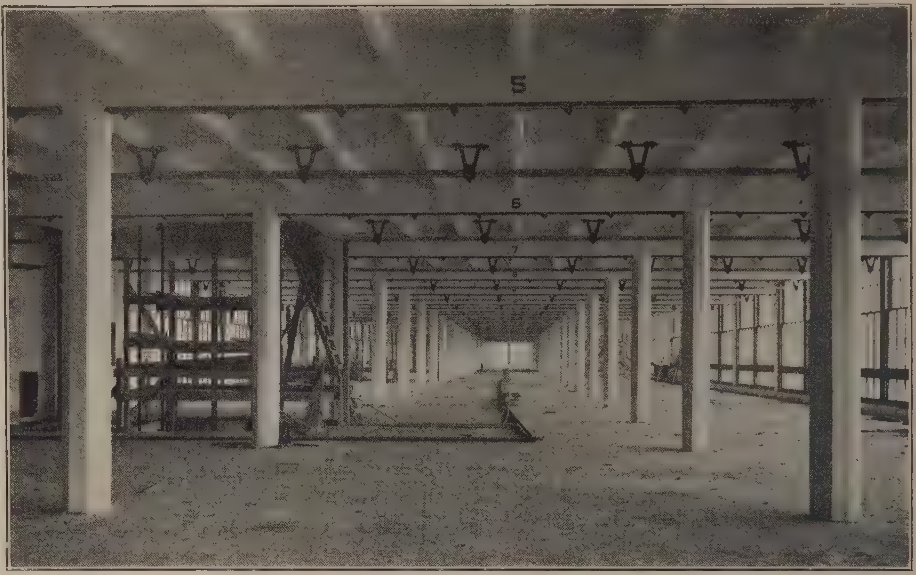
Great care was taken to test the character of the concrete as the work progressed. It was continually inspected by several assistants, one of whom was stationed at the mixing machine and the others where the concrete was placed in the moulds. Samples were taken every few minutes from the concrete at the machine, often as many as twenty per day, and from each sample was made two 6-in. cubes, which were tested by compression after setting one day under water and six days in air. These results were generally very satisfactory. Some of them were as follows: Floor concrete made 1:2:4 with Lehigh cement, 25 tons; cornice concrete, 1:2:4, 23½ tons; concrete for the smokestack made with one part Iroquois cement and three and one-third parts sand, rammed dry, 28 tons. Several cubes made with Atlas cement were tested to the capacity of the machine without breaking, as follows: Special concrete made with granite chips and no sand, 1:1½, 48 tons; 1:1½:3 concrete, thirty days old, 60 tons; 1:2½:6½ concrete with stone up to 1 in., thirty-seven days old, 60 tons; neat cement cube, six days old, 60 tons. The test cubes were made in small wooden moulds constructed by the contractors' carpenters, as indicated in the accompanying sketches. Two adjacent sides were permanently fastened together and the other sides were hinged at their opposite diagonal corner and engaged the other sides with shouldered bearings. These four sides formed a rectangle which was bolted to the horizontal base with vertical rods engaging slotted angles on the sides of the vertical walls. When the nuts were slackened on these rods, the mould could be instantly collapsed and the cube removed. It was easily cleaned and quickly put together again for the next cube.

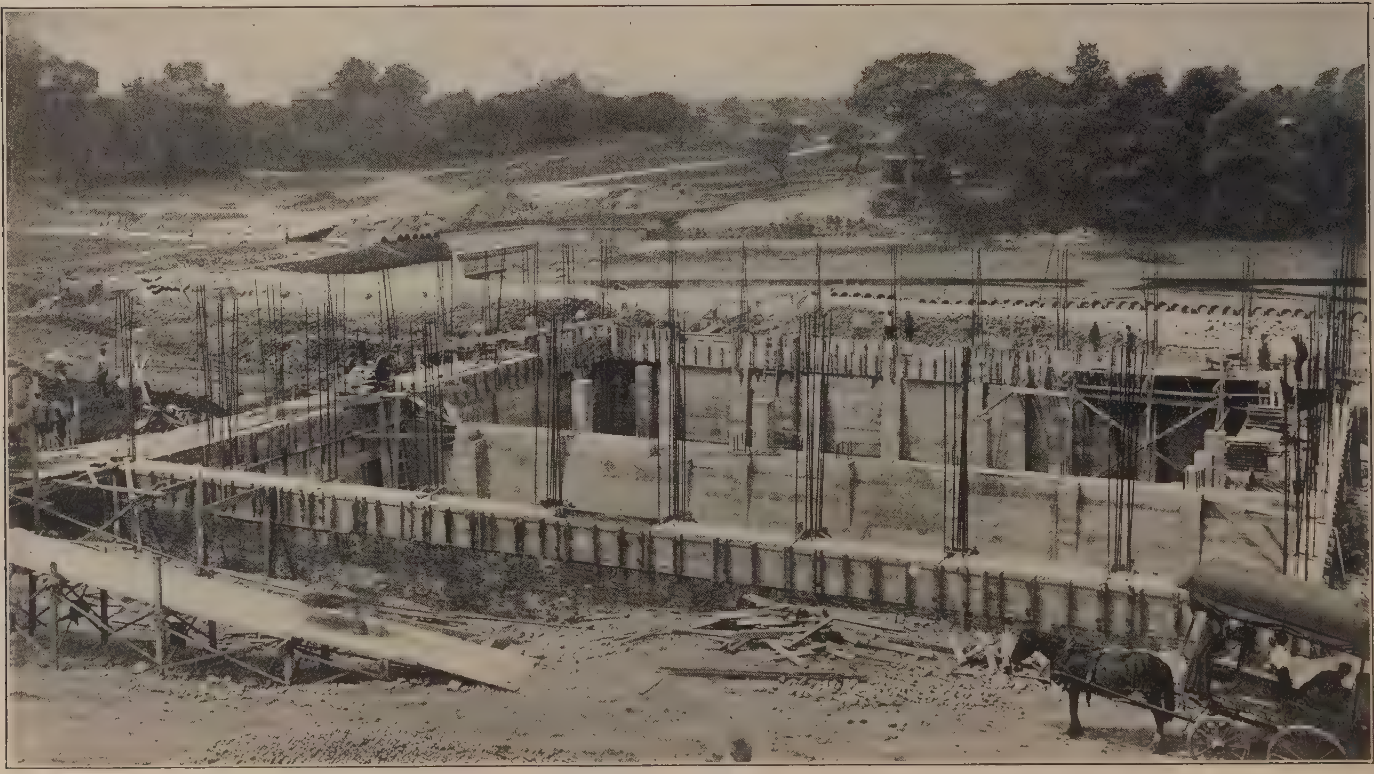


Mould for Test Cube.

The sand and stone were stored in large heaps on the surface of the ground in the positions indicated by the general diagram and were delivered by a derrick with a 60-ft. boom and a 1-yd. steel bucket to a hopper-bottom partitioned bin of about 85 yd. capacity each side, in the top of the tower, at a clear height of 24 ft. above the ground. The chutes in the bottom of the bins were fitted with gates and hand levers by which the materials were drawn off into a 2-yd. mixing hopper below them, the quantities in it being determined by gauge marks inside the hopper.

Cement in bags was stored in an adjacent house of 10,000 bbl. capacity. It was loaded in wooden skips and delivered to a concrete platform in lots of 25 bags. The required quantity was emptied on top of the other materials in the mixing hopper and the contents of the latter were discharged to the mixing machine by the operation of an ordinary gate and hand lever. A Ransome drum mixer of 24 cu. ft. capacity was set below the mixing hopper and driven continuously by a No. 7 Erie engine. Water for it was delivered from a measuring cistern and was proportioned in accordance with the instructions of the resident or consulting engineer. After a minimum of twelve revolutions the mixer discharged its contents through a chute to a shallow rectangular steel skip of 50 cu. ft. capacity, which was seated on a flat car at ground level. This car ran on a 30-in. track about 300 ft. long transverse to the main buildings at one end, and was operated by a steel cable with the bight engaging an anchored sheave. The two ends were wound on the drums of a Lidgerwood hoisting engine, which could thus move the car in either direction by operating one drum and overhauling the other. The engine used steam generated by a boiler which also served the engine for the concrete mixer, and the Lidgerwood engine provided for the derrick on the concrete tower. A Lidgerwood traveling cableway of about 700 ft. span was installed with wooden towers about 110 ft. high. These towers and their anchorages traveled on three lines of standard-gauge tracks spaced about 45 and 60 ft. apart for the tail and head towers, respectively. The tracks were at right angles to the axis of the main buildings and clear of them at both ends, so that the cableway commanded the entire area.


View in Machine Shop.


Construction of Power House of the United Shoe Machinery Co. at Beverly.

The towers were high enough so that the cable trolley had, in all positions, a clearance above the highest part of the buildings. The concrete was delivered by car from the mixer to the cableway and the latter carried the skip parallel with the axis of the buildings to the required position and there dumped it at any height necessary. It was generally dumped on movable platforms and shoveled from them into the beam, girder and column moulds. The cableway engine was of standard Lidgerwood construction. The towers were especially designed for the work and are said to be the highest of the kind ever built. The cableway was moved by tackles anchored beyond the ends of the tracks and operated by the main engine on the head tower and by a small independent engine on the tail tower. Ordinarily the cableway remained for several hours in the same position and was moved at night.

In addition to the central mixing plant, two No. 3 portable Ransome mixers with direct-connected engines, and one No. 3 Smith mixer, also with direct-connected engine, were located at convenient points and used as auxiliaries, the work with the latter mixer being especially commendable, equally in capacity, ease in handling and thorough mixing qualities. As much as possible of the work on the forms was done by machinery, and a sawmill was established close to the main group of buildings, and equipped with a band saw, a rip and cut-off saw table, two boring machines, grindstone and emery machines, all run by the Erie No. 7 engine. Duplicate repair parts for all important mechanical devices, engines, machines, etc., were kept on hand, with a result that a very small amount of time was lost through breakdowns.

The capacity of the concrete mixer was rated at 200 cu. yd. in 10 hours, and with this plant as much as 184 cu. yd. were laid in 10 hours. A record of 5,218 cu. yd. was made in one month. The complete execution of the work was delayed by inclement weather, changes in design, and other hindrances, but at times very rapid progress was made and one complete story of each of the three main buildings was built in 20 days, and a maximum force of 1,500 men was employed at once.

An interesting feature of the reinforced concrete work is a cylindrical chimney 142 ft. high from the base of the 18x18-ft. foundation 17 ft. below grade. It has a uniform inside diameter of 6 ft. and a maximum outside diameter of 8 ft. 4 in. and has a double shell in the lower part. The inner and outer shells are respectively 4 and 5 in. thick and are reinforced with vertical bars and horizontal rings of T section. The chimney was built without falsework, by means of an inside movable scaffold and two courses of sectional wooden moulds. The moulds were clamped tightly to the upper part of the finished concrete and were sustained by friction. After the concrete has set, the mould sections were disconnected and moved up on vertical steel rods passing through the upper ring a few feet above the moulds. The concrete was mixed 1:3 with Iroquois Portland cement and bank sand very dry and hoisted inside the chimney, from the upper ring. The chimney was erected by the Weber Steel Concrete Chimney Co., Chicago.

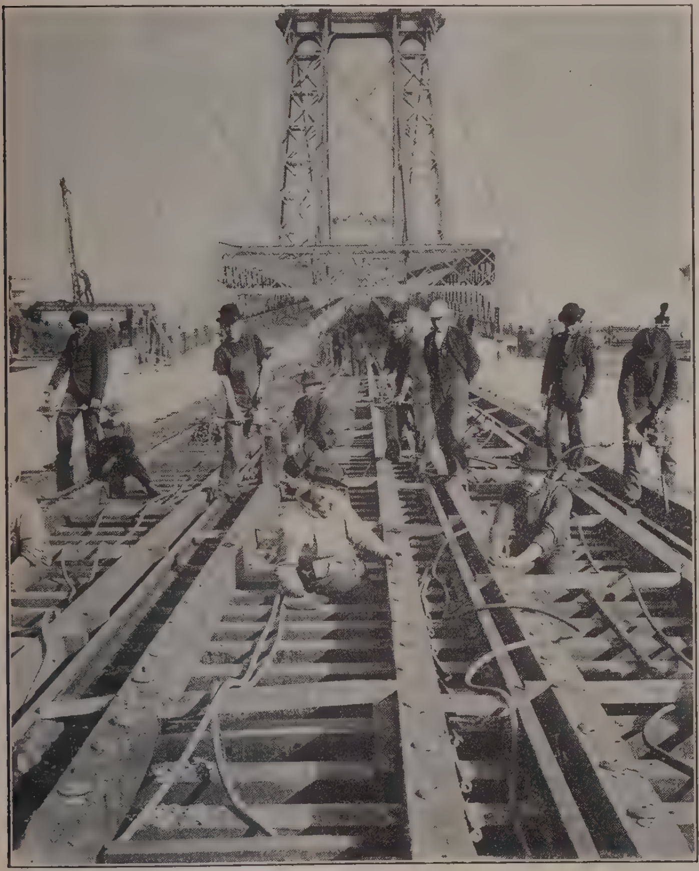
Mr. Frank M. Andrews, Dayton, Ohio, was the architect of the building, and Mr. Ernest L. Ransome, New York, consulting engineer. Mr. D. J. Andrew was superintendent and Mr. Geo. P. Carver resident engineer for the United Shoe Machinery Co., Boston, who is the owner of the plant. Messrs. R. L. Fosburgh & Sons, Boston, now incorporated as the Fosburgh Co., were the general contractors.

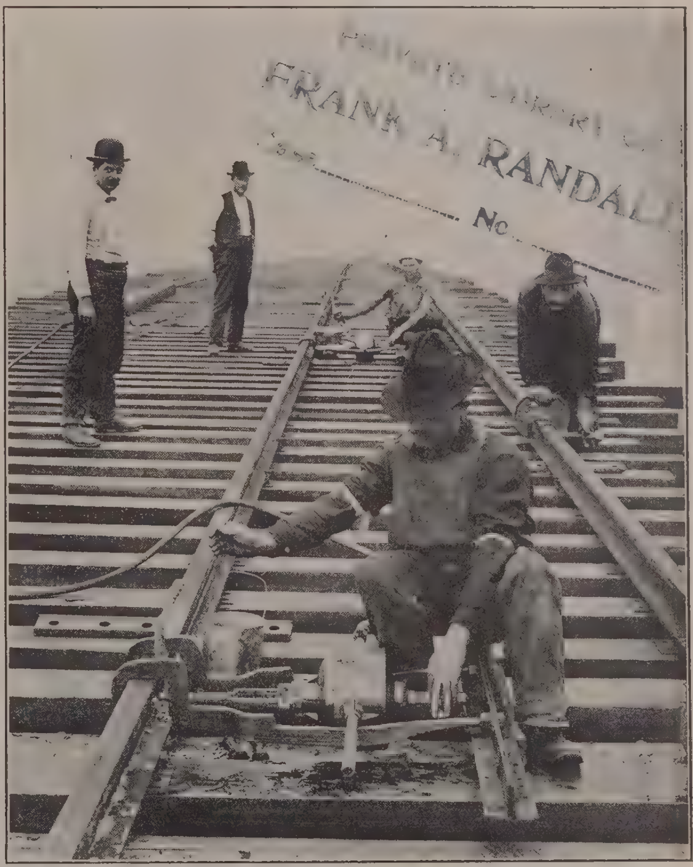
Track Laying on the Williamsburg Bridge.

The tracks for the two lines of elevated railroad, and the two lines for electric street cars, crossing the Williamsburg bridge and approaches, aggregate about five miles in length and are all laid with 5-in. 80-lb. rails of the Am. Soc. C. E. section; 7x8-in. yellow pine cross ties, treated with the creo-resinate process for wood preserving; 5x8-in. Glendon flange tie-plates and with 30-in. 6-hole Weber rail joints. The ties are spaced 21½ in. apart on centers, and are seated on the top flanges of the stringers, to which they are fastened with ⅞-in. hook-bolts at every bearing. In the outer trolley tracks the length of ties is alternately 9 ft. and 10½ ft., the longer ones projecting beyond the outer edge to carry sidewalk planks. In the inner trolley track one-half of the ties are 9 ft. long, half the remainder are 10¼ ft. and the other half are 11½ ft. long, the projecting ends carrying a foot walk. Ties for the elevated railroad, which are continuous under both tracks, are in lengths of 19½, 20, 23 and 24½ ft. A 6x6-in. guard timber is bolted to each tie 4 in. inside each rail, 8 lines in all, and the 6x8-in. guard timbers on the outside of each elevated railroad rail, four lines in all, are secured to each tie with the same hook bolt which fastens the latter to the stringer.

This construction required in all about 1,100,000 ft. B.M. of timber, 650 tons of rail, and 150 tons of bolts and washers. The ties being in so many different lengths, and the mills sending the timber forward irrespective of its position in the finished work, greatly increased the labor and expense of laying over what would have been required had all ties been of the same length. All timber was delivered by lighters from the works of the United States Wood Preserving Co., two-thirds being delivered on the Manhattan side and one-third in Brooklyn. On the Manhattan side all material had to be received at a pier about 30 ft. wide and 150 ft. long, part of which was covered with a shed in which were stored tie-plates, bolts, washers, spikes and joints as they arrived. A vacant lot across the street at head of the pier and under the bridge was used to store about 400 tons of rails, which arrived before the ties, and on this lot was installed a boiler and air compressor, and also a double-drum engine for hoisting material up to the bridge. Ropes from the drums ran up about 140 ft. to the top lateral struts of the bridge truss, whence one of them continued along the center line of bridge and down to the landing point on the pier; the other was led down between the elevated and trolley tracks near the rail storage; by this arrangement the hoister always had the load in view until it got above the floor beams of bridge.

It was required that all tie plates should be bedded in the ties before the rails were laid, and as the process of sledging them in was inaccurate, slow and expensive, two portable hydraulic tie-plate presses were used to force the plates into the ties before the latter were distributed. This portable tie-plate press was developed by Mr. C. W. S. Wilson, Assos. M. Am. Soc. C. E., engineer for Naughton Company, contractors, while laying tracks in the Rapid Transit Subway, New York. The idea was taken up with the Watson-Stillman Co., New York, and with data furnished by Mr. Wilson, they designed and built a portable tie-plate press, which has put in ties about 100,000 plates of the Q. and W., Glendon and Goldie types, besides special plates for curves which extend under both guard and running rail. It was determined by experiment that a pressure of about 40 tons was required to force a plate into a knotty yellow pine tie, and the machine was designed to furnish this pressure at each plate.


Boring Ties and Guard Rails with Pneumatic Tools.



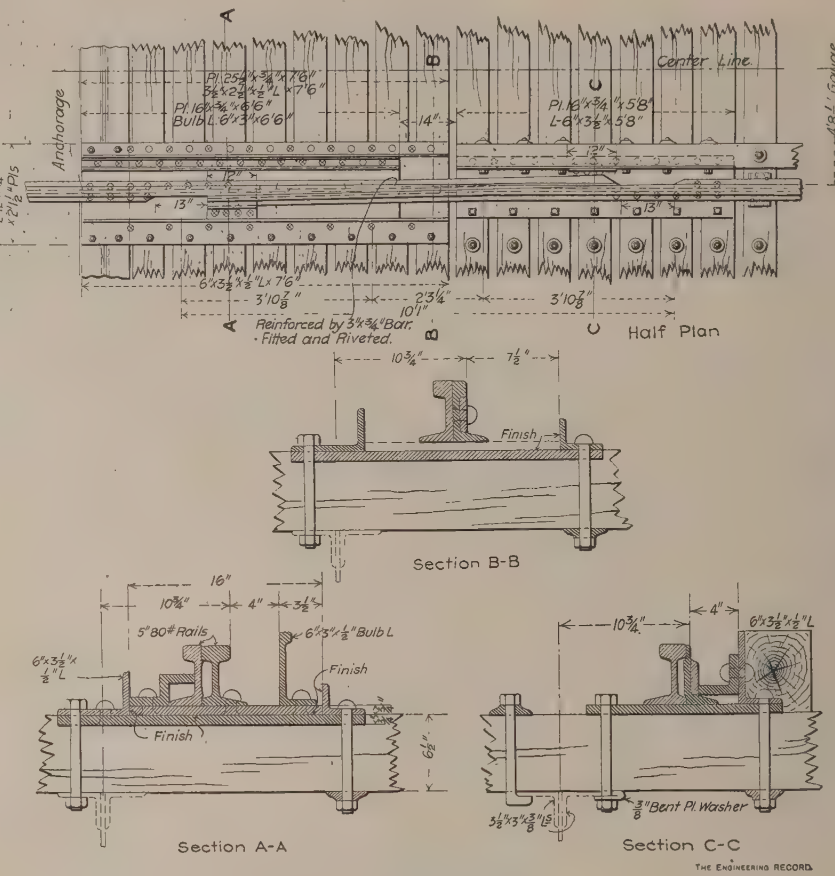
Drilling Rail Splices with Pneumatic Tools.

The press consists of two open-jaw press frames, the cylinders being set in the base of the frame and connected with a small hydraulic pipe. Each cylinder contains a plunger about 6 in. in diameter, the tops being about 10 in. square and having two ½-in. pins extending about ¾ above the top to hold the plate-gauge bar in position. On one side of the bar, four square bevel pins, two in each end, extend through the plate and about 5/16 of an inch above it, the distance between the pins corresponding to the distance between the holes in each end of the tie-plate, and the distance between centers of each pair of pins being the distance from center to center of rails for a standard gauge. On the opposite side the holes for pins are placed nearer the ends of the plate gauge to allow for widening the gauge of the track on curves. The frames are screwed to two 4x12-in. bed timbers, 8 ft. long. A stop bar is fastened to the top of the frame, and is adjustable at either end, to receive the end of the tie.

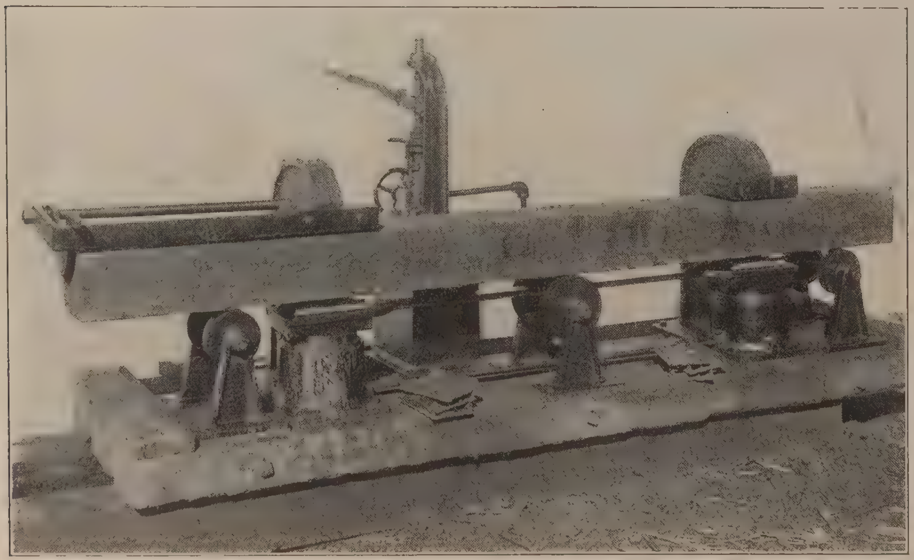
The hydraulic pipe between cylinders is connected with a Watson-Stillman portable test pump, set between the frames just back of the guide bar. This pump, which is operated by hand, has two plungers, one of large diameter for low pressure and a smaller one for high pressure. The operator, by turning a clutch on the piston, changes instantly from low to high pressure. To simultaneously put the four plates in the long ties of the elevated R. R. tracks, a second press was built like the one described and a long guide bar replaced the two separate ones.

As the ties were unloaded from the lighter, they were delivered on the rear rollers and were run forward under the jaws of the press frames. The tie plates were previously placed on the gauge bar pins, and a few strokes of the low pressure plunger forced the plate into the tie, one man easily putting a pressure of 15 tons on a plate. On the down stroke of the pump the operator threw on the small plunger and increased the pressure up to 40 tons per plate, according to the density of tie or knots encountered. One man in front of each press put plates in position. The man at the rear press recorded the length of the tie; the man at the head press marked the length on the tie and put a small daub of paint on the end of the stop, to designate the lining end of tie plates. While the local conditions were not favorable for rapid work, the ties were plated as fast as they were unloaded from lighter. During the laying of track in subway as many as 160 plates were put in ties in an hour, while the best day's work of eight hours with eight men was 1,080 plates, the men taking 20-minute shifts on the pump.

As the ties came from press the different lengths required were placed together, chained in bundles, hoisted to the bridge floor and there loaded in lots of 35 on hand cars fitted with heavy brakes and ran by gravity from the hoisting points toward the ends of bridge. Every third load carried was of rails. The ties were distributed and approximately spaced and the rails laid and spiked to one tie near each end; one track being pushed through first and used for distributing the material for the others.



Expansion Joint for Rails.



Hydraulic Machine for Setting Tie-Plates.

As soon as the rails were all laid in one direction from a hoisting point, the bonding was commenced. Each joint was bonded with two 250,000 C.M. Mayer & Englund type of protected rail bonds, 9 in. long with ⅞-in. terminals. All boring, both in metal and wood, was done with Haesler piston pneumatic drills.

Compressed air at 90 lb. pressure was supplied by a 10x10¼x12-in. Ingersoll-Sergeant Class A air compressor, located at the boiler house underneath the bridge on the Manhattan side. A 4-in. pipe starting from a 3x6-ft. receiver, was carried to the Manhattan tower and up the side of the tower to the trolley tracks, and thence on the ties between tracks, to the opposite ends of the bridge, a total distance of about 7,500 ft. Valved T outlets were placed about 150 ft. apart and expansion joints were located near the movable ends of the main span. The compressor had a capacity of 175 cu. ft. of free air per minute and operated six drills at once. The four ⅞-in. bond holes in the web at each joint were center-punch marked from templates, and were drilled in about 5 minutes. The thrust of the drill was taken by a 3x3-in. angle 3 ft. long resting on the ties with a rod in each end hooking over the head of the rail; the drill rested on these rods as on a pivot, and so was easily adjusted to the center-punch marks.

One man operated a drill, and after opening the throttle, he turned the feed screw with one hand and with other kept the drill cool with water. No oil was used on the cutting edge of the drill, so as to insure a perfect contact between the clean steel and copper bond. Individual holes were often bored in the 7/16-in. web in from 35 to 45 seconds. The best day's work of 9 hours being 262 holes for one machine, the loss of time being caused by changing the "old man" and machine from joint to joint, changing hose connections and drills. Each joint was immediately bonded by two men, who, after wiping the holes dry, placed the bond in position and upset the terminals with a double-screw compressor. All joints were bonded within one hour of time of boring. Weber joints were then put on and bolted up tight and the track spiked up and lined to its final position.

Guard timber came in lengths of 25 to 45 ft. Lap joints 8 in. long were cut in the end of each timber, and on Sundays the guard rail was hoisted and distributed along the track, and both ties and guard bored with pneumatic wood-boring machines, all holes being 15/16 in. in diameter. Ties were fastened to the top flanges of track stringers with ⅞-in. hook bolts, having a 1-in. square section for one inch above hook. The guard timber between rails was fastened to each tie with ⅞-in. machine bolts with a round, flat washer on the under side of the tie and a bevel washer on top of the guard timber. Hexagon nuts were used on all bolts. About 400 holes for one mcahine was an average day's work.

Locomotive Crane on Thebes Bridge Pier.

After the completion of the work, the Brooklyn Rapid Transit Co., which operates cars over the bridge, requested the city to have the ends of all bolts in the guard timbers in the trolley tracks cut down to the top of the timber. This necessitated removing about 15,000 bolts, shortening them 3 in. and rethreading; also counterboring the guard timber 1½ in. deep, to receive a cup washer 2½ in. in diameter. For this counterboring a special bit was constructed from a piece of tool steel 15/16 in. in diameter and about 8 in. long, one end of which was turned down to fit the socket of the wood-boring machine, and the other rounded to enter the hole originally bored in the guard timber. About 1½ in. above the rounded end a slot was cut through the bar and a cutter, such as is used in extension bitts, was placed in it and held in position with a short set screw. Through a ⅜-in. hole 1½ in. above the cutting edge was driven a pin about 4 in. long, which gauged the depth of hole to be bored. About ½ in. of thread was cut on the bar just above the rounded point, thus making the cutter-feed independent of the operator. The holes were given a heavy coat of Cerion paint, the cup washers immediately put in place, and after the timber was all bolted up they were filled with Portland cement grout.

The expansion joints provide for a longitudinal movement of 14 in., and one is placed in each track at each end of the main span. In the elevated tracks they are placed partly on the fixed structure over the anchorage, and partly on the movable span, and on the trolley tracks they are placed entirely on the movable span adjoining the anchorages. They are made by beveling the ends of the rails with a long cut in a vertical plane, and reinforcing the web so as to allow a long sliding contact. The beveled rails overlap each other about 8 ft., and each rail is rivetted to a 16x¾-in. sole plate about 6 ft. long, their ends resting on and sliding freely along the adjoining plates. A 6x3½-in. angle is rivetted on the inside edge of the plate 4 in. from the gauge line, and forms the inside edge of the guard timber. Another angle 12 in. long is rivetted to this 6x3½-in. longitudinal angle, and one edge fitted against the web of the sliding rail at the point, to prevent the rails from separating as they move back and forth. The head of the inside sliding rail is cut almost entirely away at the thin end, and it is reinforced by a 3x¾-in. bar 5 ft. long fastened to the web with countersunk rivets. The 16x¾-in. sole plates are bolted to the ties and top flanges of track stringers, insulated fiber thimbles and washers being used to prevent the return current escaping from the rails to the structure. The expansion joints for trolley tracks are of the same general character except that an additional base plate with guide angles rivetted to it is bolted to the ties, and in this the sole plate adjoining the anchorage slides. All expansion joints are built so that cars trail the moving point.

The track work was designed and executed under the direction of the Department of Bridges, Mr. George E. Best, commissioner; Mr. O. F. Nichols, chief engineer; Mr. Kingsley L. Martin, engineer in charge. The contract was awarded to Naughton Co., contractors, for $128,425, they being the lowest bidders. The work was carried out under the supervision of Mr. C. W. S. Wilson, engineer for the contractors, Mr. John Fitzpatrick being superintendent in charge.

Construction of Thebes Bridge Pier, Using Face Masonry as Cofferdam.

A Very Large Railroad Station has been undertaken at Leipzig, Germany. It will have thirteen platforms, each over 1,000 ft. long, and the trainshed will have seven arched spans of about 140 ft. each. The station will cost about $35,000,000, of which $4,000,000 will be contributed by the city.

Construction of the Thebes Bridge Piers.

The five long double-track spans of the Thebes bridge across the Mississippi River are supported on two abutment piers and four river piers as shown in the general description published in The Engineering Record of Nov. 12, 1904. The river piers are built of Romona colitic limestone with concrete backing and have wooden pneumatic caissons carried down into solid rock at a maximum depth of about 50 ft. below low water. Above the tops of the rectangular caissons they have parallel sides and pointed ends and at a height of 39 ft. above low water have a starling course, just above ordinary high water, above which the piers are made with semicircular ends, and are carried up with a batter of ½ in. per foot on all sides to the coping 95½ ft. above low water where piers 2, 3, 4 and 5 are 12 ft. wide and 39 ft. long between shoulders. Piers 1 and 6 are similar but have somewhat smaller dimensions and all are sunk to different depths.

The caisson for pier 3 is 34½ ft. wide, 82½ ft. long and 29 ft. high and weighed about 400 tons when launched. It was built up to its full height on transverse timbers across the decks of two round-bottom barges and was launched by scuttling the barges. The other caissons were built on flat-bottom barges. The caissons were moored near the shore, completed, towed to position and landed in the usual manner in water from 20 to 26 ft. deep with a current of 2 or 3 miles at low water. The irregular sloping surface of the rock was practically bare except at Pier IV. It was therefore useless to try to protect the work with piles or to moor the caissons to them, and crib anchors were provided to keep them in place. At Pier III. seven 10x10-ft. stone filled anchor cribs about 8 ft. high were sunk in a line about 150 ft. long at right angles to the axis of the pier and arranged symmetrically on each side of it about 500 ft. up stream. Steel cables 1-in. in diameter were secured to the cribs and passed around sheaves bolted to the end of the caisson. From these sheaves the cables led up over the top of the caisson wall and to cross struts in the interior bracing, around which they were looped and secured by clamps. In order to shift the caisson, tackles were clamped to the cables just inside the walls, and as the cables were pulled in or slacked off the ends were overhauled around the braces and clamped in their new positions. Four smaller crib anchors were sunk on both sides of the caisson to anchor it laterally.

The caissons penetrated the rock a maximum distance of about 25 ft., and as there was little sand to develop skin friction it was considered inexpedient to build on the full weight of the masonry and concrete backing up above water level and load the caisson excessively during sinking. Therefore the face masonry was built as required to keep above water before the concrete backing was laid, and the inner ends of the long header stones were temporarily supported on 12x12-in. blocking. The facing stones were in courses from 2 to 3 ft. high, were generally planed on beds and sides and had rock-faced inner and outer ends. They were laid with ½-in. joints in 1:2½ cement mortar and formed a wall that was waterproof even under a maximum of 30 ft. head, and this was used as a cofferdam without any wooden cofferdam. The leakage through it was practically nothing, and pumps were used only to fill it with water or to remove the water so admitted to sink the caisson. Several times during construction the piers were submerged by floods, but no damage was done to the masonry.

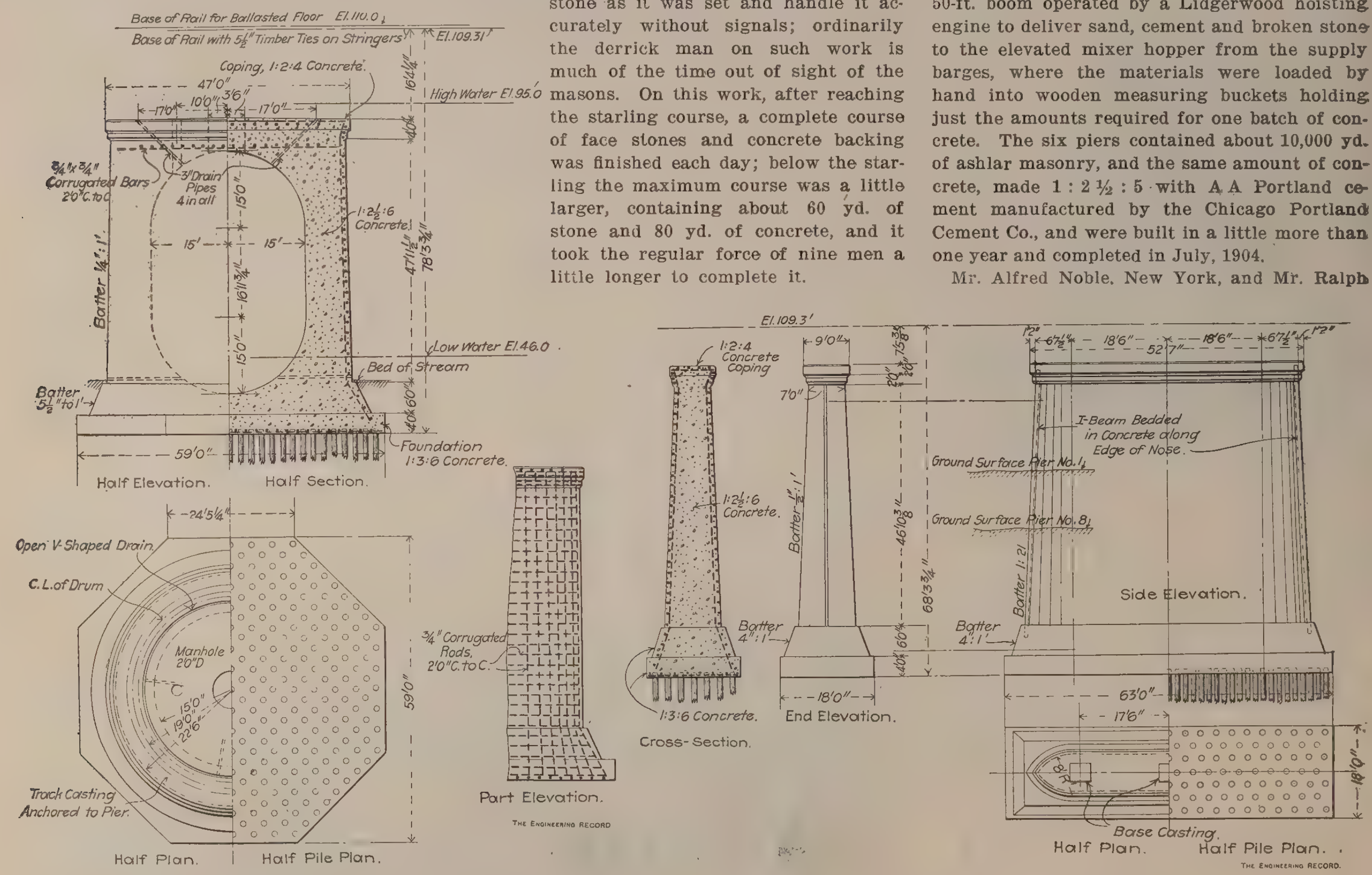
The Mississippi River carries great quantities of drift when rising. In one instance there were such quantities of it that during a single night it accumulated under a derrick barge moored to one of the piers to such an extent that the barge could not be moved up stream by the united efforts of a steamer and its own winches winding on anchor ropes. After it had been released a long time was necessary to get the drift disengaged from its bottom, a process which resulted in lowering the boat a considerable distance, it having been raised almost out of the water by the drift which had collected under it.

The dimensions of the piers were too great to enable any ordinary floating derrick to handle the masonry of the upper part; stiff-leg or guyed derricks on the masonry would have been difficult to move up as the work progressed, and derricks seated on adjacent falsework towers would have required very long masts and booms and tall, wide towers which would have caused serious obstructions by intercepting large quantities of drift. It was therefore determined to adopt the unusual expedient of installing a locomotive crane on the pier, running from end to end on a movable track and being lifted up as the work progressed. This plan was carried out and the results were considered very satisfactory by the contractors, who believed that the masonry was thus laid much more quickly, easily and economically than would otherwise have been the case. A great advantage was recognized in the fact that the crane operator was always close to the masons and could see each stone as it was set and handle it accurately without signals; ordinarily the derrick man on such work is much of the time out of sight of the masons. On this work, after reaching the starling course, a complete course of face stones and concrete backing was finished each day; below the starling the maximum course was a little larger, containing about 60 yd. of stone and 80 yd. of concrete, and it took the regular force of nine men a little longer to complete it.

A locomotivé crane was installed on each pier successively as it reached a height of about 38 ft. above low water. It was of the McMyler pattern, furnished by the Dodge Coal Storage Co., of Philadelphia. The crane weighed about 30 tons, had a capacity of 6 tons at 25-ft. radius and was traversed on two 15-ft. sections of 8-ft. gauge track supported, before the backing was laid, on 12x12-in. transverse timbers laid across the face stones. After laying a course of masonry from one end of the pier up close to its last position the crane was jacked up with its track to the level of the top of the last course and moved over on the other section of its track laid there. It then completed the part of the previous course, left unfinished under its former position, and, after filling in the packing, added a new course beginning at the end of the pier and working to the opposite end, where it was again raised as before described, and so on. The derrick hoisted all the ashlar stones, which weighed up to 8 tons each, as well as the 1-yd. skips of concrete and mortar from the four attendant barges. When the pier was completed the crane hoisted up complete a small stiff-leg boom derrick from the barge alongside and seated it on top of the pier. With this derrick, which had a 20-ft. 8-ton boom, the locomotive crane was taken to pieces, and its separate members, weighing about 6 tons maximum, were lowered to the water level.

The two abutment piers, Nos. 1 and 6, were built with mast and boom derricks, but all the concrete for the six piers was mixed in a one 1-yd. double-worm, open-trough machine manufactured by the Iroquois Iron Works, Buffalo, and by a Smith 1-yd. double-cone machine manufactured by the Contractors' Supply & Equipment Co., Chicago. Each machine was installed on a separate barge, and work was thus maintained simultaneously on two piers. The concrete barges each had a stiff-leg derrick with a 50-ft. boom operated by a Lidgerwood hoisting engine to deliver sand, cement and broken stone to the elevated mixer hopper from the supply barges, where the materials were loaded by hand into wooden measuring buckets holding just the amounts required for one batch of concrete. The six piers contained about 10,000 yd. of ashlar masonry, and the same amount of concrete, made 1 : 2½ : 5 with A A Portland cement manufactured by the Chicago Portland Cement Co., and were built in a little more than one year and completed in July, 1904.

Mr. Alfred Noble, New York, and Mr. Ralph Modjeski, Chicago, are the chief engineers of the bridge, and the substructure was built by C. Macdonald & Co., of New York, to whom we are indebted for the foregoing information.

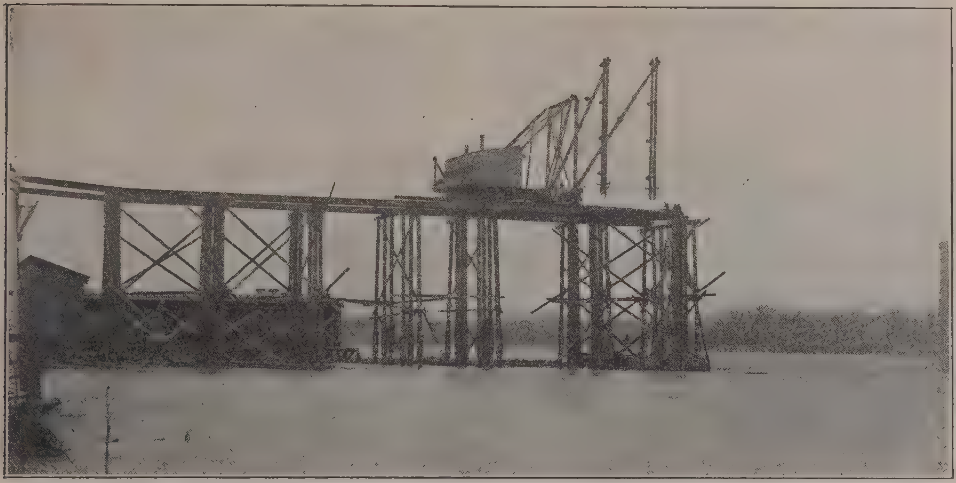


General Dimensions of Piers of Gilbertsville Bridge, Illinois Central Railroad.

The Sewerage Tunnel for Worcester, England, under the Severn River, for bringing the sewage collected on one side of the river to that obtained on the other, so that all of it may be treated in filters at Bromwich, has been progressing at the rate of one-half to one yard in 24 hr. It is being built of iron rings 6 ft. in. in diameter, but the height is lessened by an 18-in. bed of concrete in the bottom on which the pipes of the siphons rest. The soil encountered is hard, rocky marl, necessitating the occasional use of dynamite. As the building of the iron rings proceeds, liquid cement is forced behind by compressed air, so that the tunnel may be said to be encased in cement. The tunnel length is about 300 ft., 25 ft. below river bed. The long history of tunneling under the river now has a modern chapter.

REINFORCED CONCRETE PIERS OF THE GILBERTSVILLE BRIDGE.

The double-track three-truss Illinois Central R. R. bridge across the Tennessee River at Gilbertsville, Ky., has a swing span and eight fixed spans with reinforced concrete piers from about 60 to 71 ft. high from bottom of footing to top of coping. All of them have pile foundations cut off 14 ft. below low water and penetrating 1 ft. into the first footing course, which is 4 ft. high with vertical faces. The second footing course is uniformly 6 ft. high with a variable offset and large batter, terminating 5 ft. below low water level and carrying the slightly battered shafts of the fixed span piers and the vertical shaft of the pivot pier.



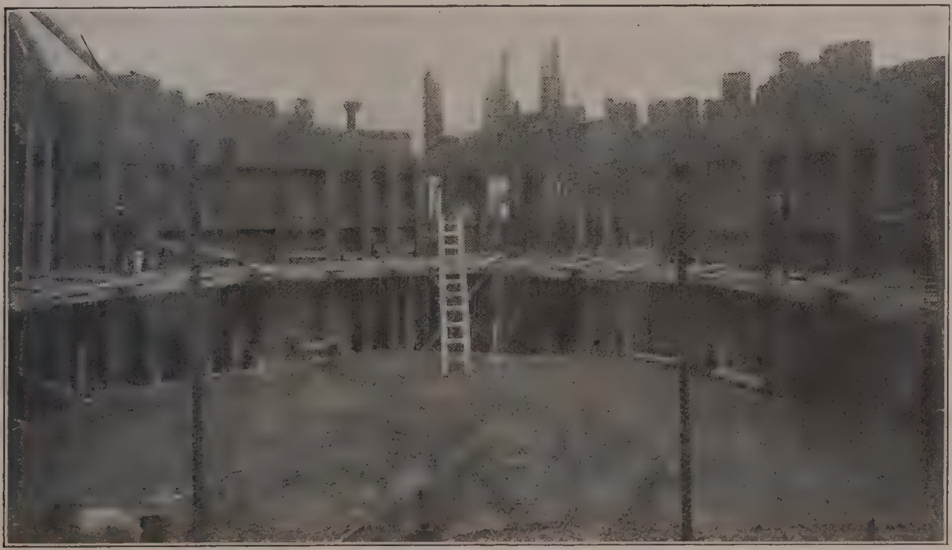
Falsework Pile Driver with Double Overhanging Suspended Leads.

The fixed piers correspond to the one here illustrated except for difference of dimensions. The others being wider and longer as well as higher. The maximum footing is 33x72 ft. with 306 piles in the foundation, 2,158 cu. yd. of concrete and 16,900 lb. of reinforcement steel. The pier shown has 1,255 yd. of concrete, 144 piles and 12,100 lb. of reinforcement bars. The reinforcement rods are all ¾-in. patent corrugated bars with joints in adjacent lines staggered at least 5 ft., lapped 18 in. and wound with at least two turns of No. 16 galvanized wire. All of them are placed about 6 in. from the surface of the concrete and are held in place by tying the intersections of vertical and horizontal bars with wire.

Concrete Plant and Pier Moulds.

The vertical rods are continuous from coping to foundation to bond the footing and shaft courses together and are bent at the foot of the shaft so as to spread out nearly to the toe of the footing. The lower surface of the footing is reinforced by two crossed layers of bars laid in the centers of the spaces between the rows of piles and similar reinforcement is provided for the upper surface of the coping. The ends of the piers are additionally reinforced by 8-in. I-beams bedded in them so that one flange projects just beyond the concrete surface. One beam is bedded in the center of the sharp convex up stream end, and one in each corner of the square down stream end. An attractive and symmetrical finish is given to the top of the pier by interposing an offset course between the coping and the shaft and placing concave and convex fillets at the upper and lower angles, thus giving the effect of neat mouldings. The upper edge of the coping is beveled 2 in. deep and 6 in. wide, and the surface is troweled very smooth and three rectangular steel castings are set 17½ ft. apart on the center line for the truss bearings.

The coping, foundations, footings and reinforcement of the pivot pier correspond with those of the fixed piers except that the upper course of the footing is made integral with the shaft, and that the vertical I-beams are omitted. The pier is made hollow with an interior space made up of a 30-ft. vertical cylinder with hemispherical ends and is accessible through a 24-in. vertical manhole through the coping. About 6 in. clear of the upper end of the cavity there is an additional horizontal reinforcement consisting of two crossed tiers of bars. The coping is pitched slightly from the center and edges to an open circular channel, about 34 ft. in diameter, which is just inside the track circle. It has a width of about 3 in. and a depth of from 1 to 3 in. pitching from four summits to four inclined 3-in. drain pipes which discharge into the interior of the pier. The interior is drained, except a small part of the bottom, by four horizontal 3-in. pipes just above the footing.



Interior of Cofferdam for Pivot Pier.

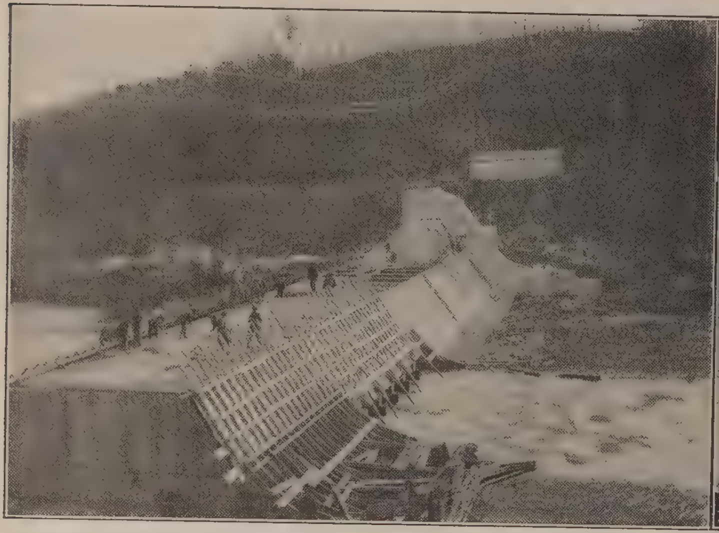
The concrete was made with Owl Portland cement and was mixed in a Smith machine, and driven by a 16-h.p. gasoline engine, which with the derricks, boilers and materials were located on barges moored adjacent to each pier successively. The piers were built in open sheet pile cofferdams which were kept always drained by centrifugal pumps. The earth inside the cofferdams was excavated to a maximum depth of nearly 40 ft. before the piles were driven and the first footing course was filled in over the whole bottom area sealing it, before the forms were built for the upper part of the footing and the shaft.

The forms were planed on the inside and left a smooth, handsome finish on the concrete. The reinforcement bars were thoroughly secured to blocks on the forms, and were placed in two or more sections corresponding to the lengths of the vertical bars. The concrete was laid by men working some of the time in three 8-hr. shifts, and care was taken to complete a level course each day, and to thoroughly wet its surface and brush it with neat grout before commencing work the next day. The concrete was laid in 6-in. layers well rammed with 16-lb. rammers and carefully spaded around the forms so as to work all stones back from the surface. In the coping the stone was broken to a maximum diameter of ¾ in. and elsewhere to a maximum of 2 in. Because of the necessity for pushing the work the forms were not used over again on successive piers. The piers were designed and constructed under the direction of the engineering department of the Illinois Central R. R. Co. Mr. H. O. Wallace, chief engineer, and Mr. H. W. Parkhurst, engineer of bridges, succeeded Mr. F. H. Bainbridge. The Rogers Construction Co., Chicago, was the contractor.

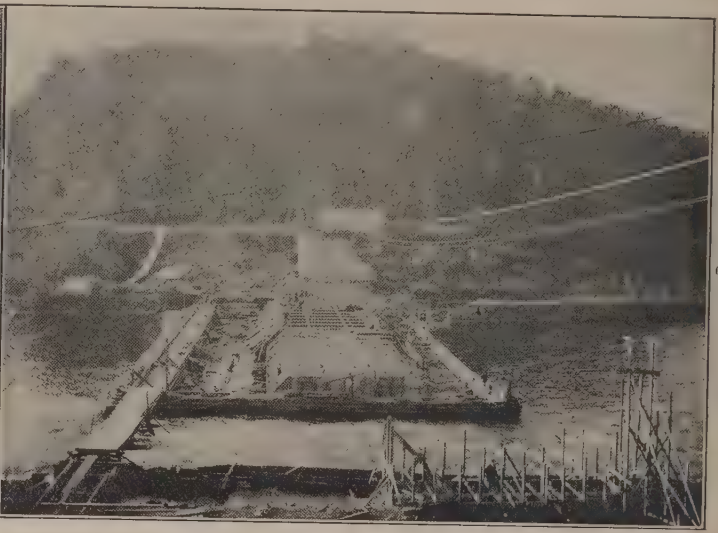
A Union Railway Station is under discussion at Cleveland. The Union Terminal R. R. Co. and a local company have two projects. The former, it is said, is likely to be adopted.

Construction of the Schuylerville Concrete Dam and Power House.

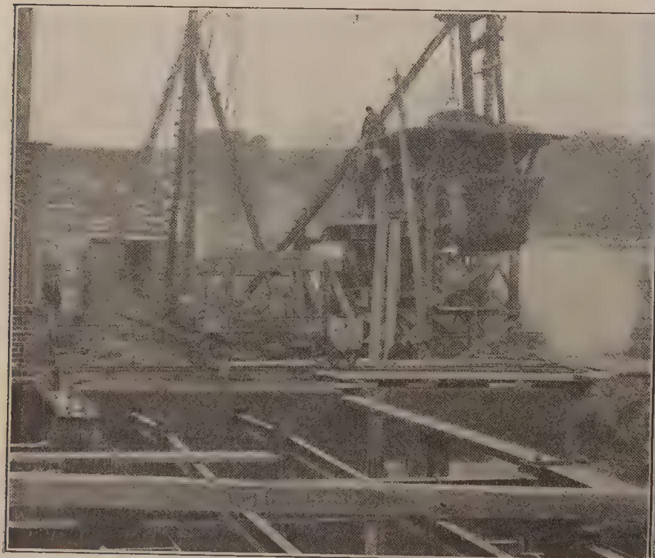
The hydraulic plant of the American Wood Board Co. on the Batten Kil River, near Schuylerville, N. Y., includes a two-story power house and pulp mill with concrete floors and walls and steel beams and columns, five steel and concrete penstocks; a hollow dam of reinforced concrete, abutments, wing walls and bulkheads of solid concrete. The construction involved the building of two cofferdams to enclose the dam site, the installation of a cableway, derrick system and concrete plant, the excavation of about 5,000 yd. rock and 1,500 yd. clay and the use of about 6,500 yd. of concrete and 70,000 lb. of corrugated reinforcement steel and about 157,000 lb. of structural steel.



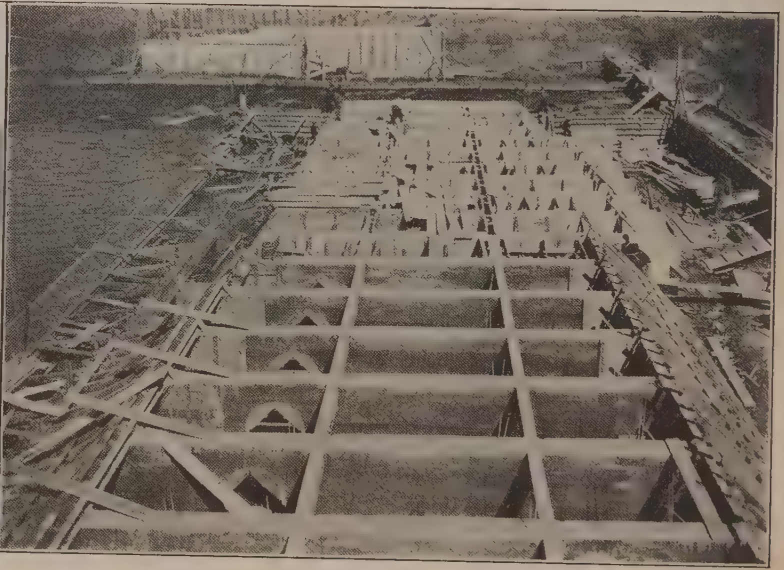
Dam after Closing By-Pass Channel.



Dam before Closing By-Pass Channel.



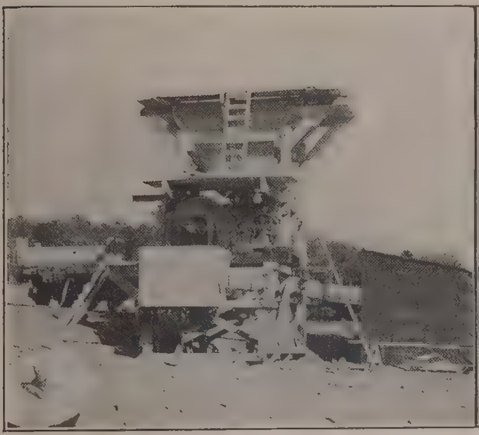
Concrete Tower and Special Bucket Car.



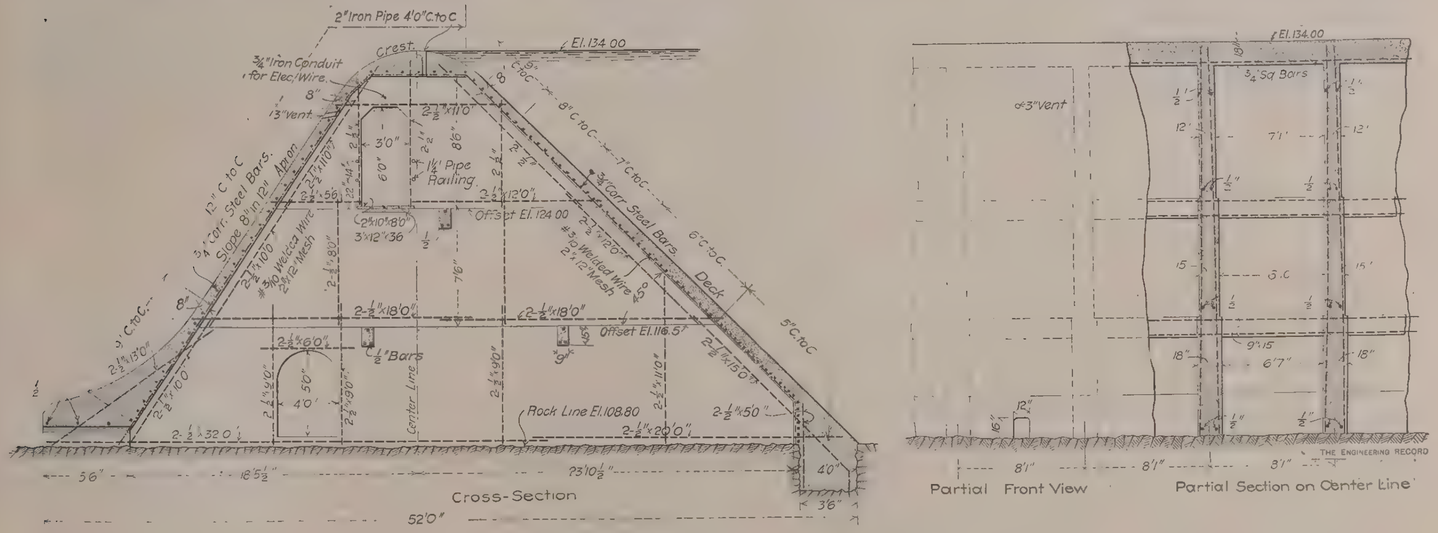
Forms for Lower Part of Transverse Walls.

The power house is about 112 ft. long, 60 ft. wide and two stories high with large masses of concrete in the foundations, bulkheads, hydraulic walls and in the piers for the five 400-h.p. turbines. The penstocks are 8 ft. in diameter inside and are made with concrete from 1 to 4 ft. thick laid in rock trenches and lined with thin steel plates. One end wall of the power house is built on the shore line of the river and is continuous, at the up-stream corner, with the concrete dam abutment about 9 ft. wide and 40 ft. long and projects 21½ ft. beyond the corner to the rack platform in the forebay. The other abutment is on the opposite shore line and is 8 ft. wide and 55 ft. long on top, 13½ ft. wide at the base and about 35 ft. high on the vertical river face, with a battered rear face. At the up-stream end it is integral with 50-ft. wing wall at right angles to it which is 3 ft. wide on top, 8½ ft. wide at the base and about 25 ft. high at the tallest point. The abutments are connected by a dam 52 ft. wide on the base, 26 ft. in maximum height and 250 ft. long at right angles to the faces of the abutments and the axis of the river. The dam was designed by the Ambursen Hydraulic Construction Co., and is composed of three tiers of transverse full length transverse cells from 6 to 8 ft. wide and high, with reinforced concrete walls and inclined aprons on the up and down-stream sides. It is seated on the leveled rock bottom of the river and at the toe has a solid transverse cut-off wall built in a trench about 3½ ft. wide and deep. The dam is divided longitudinally into 8-ft. 1-in. panels by vertical transverse walls or piers, which are the elements of the design and construction and support the horizontal and inclined surfaces of concrete which are built essentially like reinforced floor slabs.

At the dam site the river has a low water depth of about 2 ft., a current of about 5 miles an hour and flows on a rocky bed with clay and rock banks about 15 ft. high. Operations were commenced by building two cofferdams about 180 ft. long about 40 ft. each side of the dam axis and parallel with it. They were carried above water level on the north shore and their opposite ends were connected by a dam at right angles to them, thus enclosing nearly two-thirds of the dam site and leaving a by-pass channel 70 ft. wide between the south end and the south abutment and power house. The cofferdams were made with timber cribs, built in place on bare rock and in water not more than 2 ft. deep at the time of construction, and were made with two walls of 6x6-in. timbers, breaking joints and connected by occasional transverse planks built in between the courses. They were built to a height of about 7 ft. and filled with clay, well rammed, and loose stone. The up-stream dam was about 12 ft. wide between crib walls, and puddle clay covered with broken stone was filled in on the up-stream side and sloped off at a flat angle. The other dams were about 5 ft. wide and had no outside filling. The cofferdam was carried away by a flood early in the progress of the work but the timber was recovered and it was rebuilt on the original lines. It proved very tight and the interior was easily kept dry by a single 8-in. centrifugal pump.


Concrete Mixing Tower.

Concrete Bucket and Car.



Cross-Section

Partial Front View

Partial Section on Center Line

The Ambursen Type of Reinforced Concrete Gravity Dam.

A 540-ft. span cableway manufactured by the Flory Mfg. Co., Bangor, Pa., with a pyramidal timber head tower and an inclined A-frame tail tower 45 ft. high, was installed on the axis of the dam and was used to handle spoil and concrete. It was operated by a 30-h.p. Flory hoisting engine and had a capacity of 3 tons and made about 200 round trips in 10 hours.

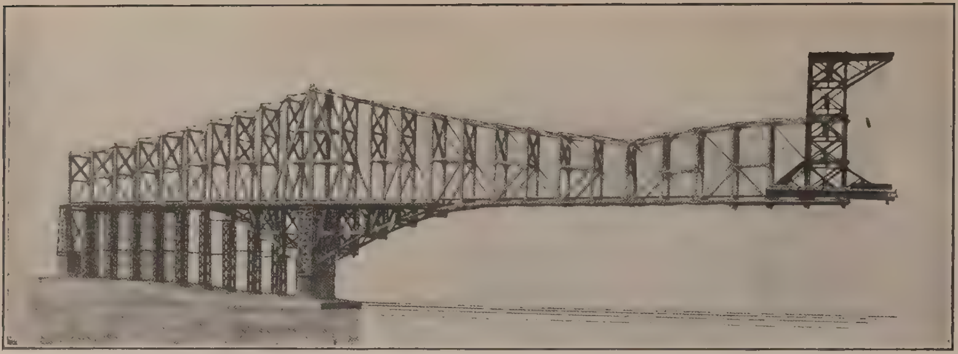
The soft rock was drilled by hand and the hard with Ingersoll-Sergeant steam machines and blasted with dynamite, the excavation being carried to a maximum depth of 27 ft. Cofferdam rock was blasted from the north bank of the river about 300 ft. upstream from the dam and was loaded by hand into steel buckets delivered by derricks to 1-yd. dump cars, and run by gravity down a light grade to the cofferdam. The empty cars were drawn back to the quarry by teams.

A Ransome Concrete Machinery Co. drum concrete mixer with a rated capacity of 200 yd. in 10 hours was installed on a tower 22 ft. high nearly in the line of the dam. Materials were delivered by a guyed derrick, operated by a Lidgerwood hoisting engine, to the top platform and filled by gravity into a measuring hopper which delivered to the mixer. All concrete was made with Iron Clad cement, manufactured by the Glens Falls Portland Cement Co., and was mixed very wet with 2-in. gravel and under, and sharp bank sand in proportions of 1:3:6 for the piers and abutments, 1:2:4 for the deck, apron, crest and toe; 1:3:5 and 1:4:8 mixtures were used for the covering over the penstocks and in some other places.

The site of the river wall of the power house and the adjacent abutment were enclosed by a crib cofferdam, and construction was commenced with the abutments and wing walls. As soon as the excavation was completed in the main cofferdam the concrete was laid in the cut-off trench at the toe and moulds were built one story high for the transverse vertical walls or piers. When these were completed the first deck was built and the aprons made up to the deck level, the concrete being rammed in layers in the moulds as the inclined outer faces of their moulds were built up in corresponding courses with horizontal boards secured by horizontal longitudinal ribs about 2 ft. 6 in. apart and 4x6-in. inclined cross strips in vertical planes. The upper part of the dam was built in similar successive operations like the construction of the upper stories of a building. In the lower story of six panels, near the middle of the river, the apron was omitted so as to leave openings through the dam to serve as sluices to discharge the flow of the river while the by-pass was closed by cofferdams similar to those first built and the remainder of the dam was built there. At these sluices the vertical transverse pier walls were continued 5 ft. beyond the up-stream face of the dam, covered with a solid horizontal concrete floor at the level of the first deck in the dam, and provided at the outer ends with grooves for stop planks with which the water was cut out after the second section of the dam had been built, and behind which the panels were finally permanently closed by vertical walls of reinforced concrete 12 in. thick.

Considerable concrete was laid when the average temperature during the daytime was about 14° Fahr., and the mercury some times fell to 4° in the night. In such weather one quart of dry salt was mixed with each 1-yd. batch of concrete and the materials were heated. A 24-in. cast-iron pipe 22 ft. long was carried horizontally through the bottom of the sand bin and served as a flue for a large coal fire maintained constantly in a brick furnace at one end. Afterwards more satisfactory results were secured by running several steam pipes through the sand. The gravel and broken stone was also heated by being piled over a cast-iron flue pipe and mixing water was maintained at about 150 deg. by discharging exhaust steam from the mixer engine into the 40-gal tank from which it was drawn by hand into the drum in quantities according to the judgment of the inspector. On the dam tarpaulins were laid over the surface of the concrete as soon as it was laid and the ends hung down well over the sides, but no heat was provided to warm the enclosed air. A canvas roof was built 2 ft. above the penstocks and in the trench beneath it fires were kept burning in two salamanders. Work was commenced in September and the dam and power house were completed the last of December, 1904.

Mr. George F. Hardy, New York, was the engineer and architect of the entire plant. Messrs. Tucker & Vinton, New York, were the general contractors; Mr. P. H. Trout, superintendent, and the Ambursen Hydraulic Construction Co., Boston, were sub-contractors for the elaborate falsework and moulds for the dam.

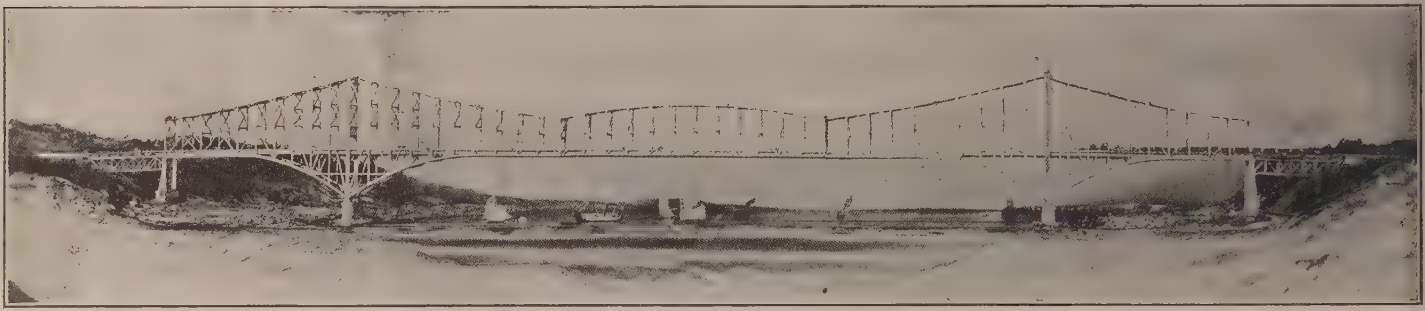


Model Showing Cantilever Erection.

THE ERECTION OF THE QUEBEC BRIDGE.

Building the Longest Span Bridge Undertaken in Any Country.

Over $1,000,000 has been spent at the site, the substructure has been completed, the designs for the superstructure are far advanced, over 6,000 tons of the steelwork has been fabricated at the bridge shops, and work has been commenced for the installation of a $250,000 plant for the erection of the longest bridge span in the world. The final formalities for the contract for the superstructure of a railroad and highway bridge across the St. Lawrence River about 8 miles west of Quebec, Canada, were completed in April, 1904, and the bridge is to be finished by Dec. 31, 1908, at a total estimated cost of $3,800,000. Matters have therefore progressed so far that the construction is assured; most of the important features of design and erection are settled and many of the details fixed, but very little information, and none of a precise nature, has yet been published concerning the superstructure. This article will outline the general character of the main spans, giving their principal dimensions and sufficient information concerning the members and connections to make intelligible a description of the preliminary operations of the erection and the general methods employed and plant to be installed for the execution of one of the most important engineering constructions and the largest of its class ever undertaken.



Completed Quebec Bridge, from a Photograph of Model.

At the bridge site the river flows between steep sandstone banks about 200 ft. high and has a bed of cemented strata, practically hard pan, covered with large glacial boulders. It is from 2,000 to 1,800 ft. wide at high and low tides, respectively, has a maximum depth of 200 ft. for a long distance each side of the center line, and has an average tide of about 15 ft. and a maximum current of about 8 miles an hour. It is not subject to floods, but enormous fields of very thick ice are swept through it every year. In order to avoid very deep foundations the two channel piers were placed 1,800 ft. apart on centers, and the two shore piers 2,800 ft. apart on centers; the sites of the latter are exposed at low tide and the sites of the former are in water about 10 ft. deep at low tide. Their foundations were all built with pneumatic caissons carried down to a maximum depth of about 60 ft. below low water, as described in The Engineering Record of July 27, 1901.

Design.—The bridge is designed to carry two railroad tracks, two highways, and two electric car tracks on the single deck 120 ft. above the pier tops between the trusses, which are 67 ft. apart on centers in vertical planes. Provision is also made for attaching cantilever brackets to the outsides of the trusses to carry sidewalk floors if found desirable in the future.

The bridge is 2,800 ft. long between centers of anchorage piers, and its superstructure weighs about 40,000 tons. There are two 500-ft. anchor arm spans and one 1,800-ft. cantilever span over the channel. The latter is composed of two 562½-ft. cantilever arms connected by a 675-ft. center suspended span. The pin-connected trusses are continuous from the anchorages to the ends of the center suspended span, 1,062½ ft., and are 315 ft. deep on centers over the main piers, 98 ft. deep at the ends of the cantilever arms, and 130 ft. deep in the center of the suspended span. Both top and bottom chords are parabolic curves throughout, and the lower chord has a minimum clearance of 150 ft. above high water for 1,200 ft. in the middle of the river. The trusses are braced together with lateral diagonal systems in the planes of the roadway and of the top and bottom chords, and have transverse sway bracing between the vertical posts above and below the roadway, all the secondary members having riveted connections.

The weights of the anchor and cantilever arms and of the suspended span are about 12,500,000, 15,000,000 and 6,000,000 lb., respectively, exclusive of the floor system which weighs about 8,000,000 lb. Among the largest and heaviest members to be handled in the field and erected by the traveler at great heights, are the 4½x5½-ft. lower chord pieces 68 ft. long which have a maximum sectional area of 842 sq. in. and weigh 100 tons each; the 15x2⅛-in. eyebars 76 ft. long, the 24-in. pins 7 ft. long; the 13x11½x7¼-ft. 66-ton main shoes, and the 10¼x64-ft. 30-ton floorbeams.

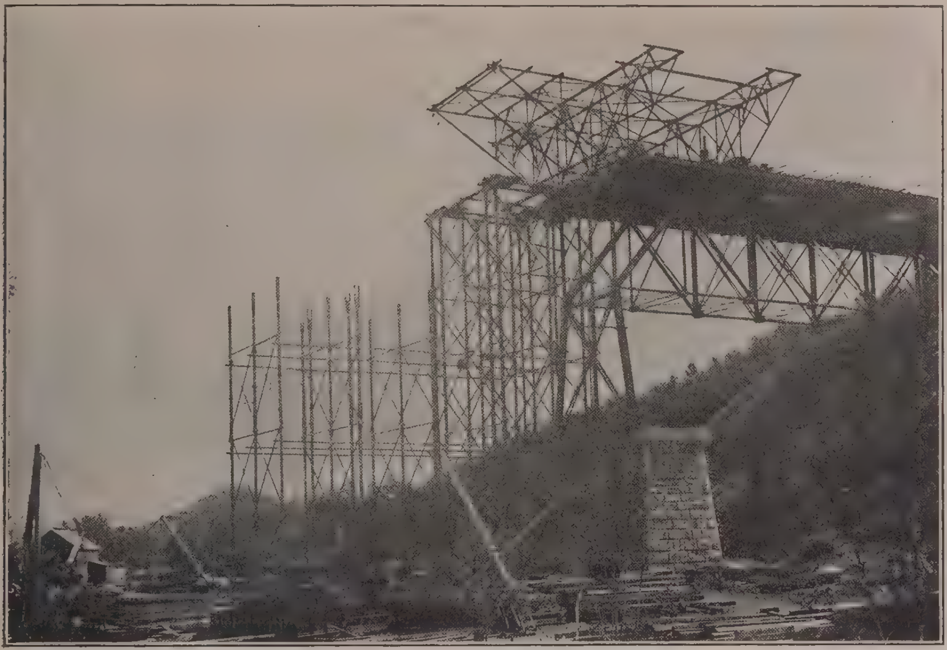
Special Considerations.—The details of the bridge and the erection methods and plant were designed by the contractor's engineers and approved by the consulting engineer. From the inception of the work great care was taken to avoid ambiguity of stresses or secondary strains, secure simple, economical and direct connections of the maximum efficiency, to adapt the work to the standard practice in the shops and the most advantageous use of machine tools, to suit the character and arrangement of members and the details of the connections to the requirements of shipment and handling and especially to the facility of erection, assembling and field-riveting.

Weight and dimensions were reduced by subdividing the largest members. To facilitate erection the trusses were designed to require the minimum simultaneous pinning of members, separate pins were provided for the diagonal members and for the chords and vertical posts; at the centers of the intermediate vertical posts the upper and lower lengths of the diagonal bars were connected to riveted cross plates on the posts with separate pins on opposite sides of the posts. At the tops of the main vertical posts the diagonals of the anchor and river arm cantilevers have separate pins through short horizontal links forming the upper ends of the posts, thus reducing the length and diameter of the pins and enabling the two panels to be assembled independently. The lower chords are chords of parabolic curves and are shop-spliced at each panel point. A second splice is introduced about 10 ft. from the pin and is field riveted to facilitate erection.

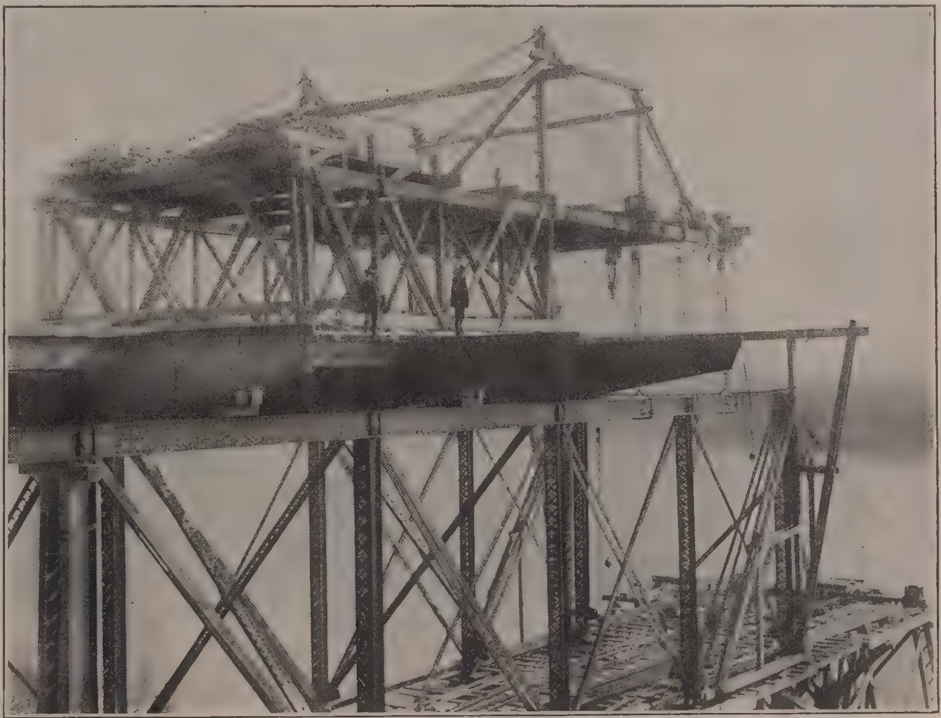
The dimensions of the separate parts of the largest members were made as great as could be shipped from the shops and as great as could be handled without making a very disproportionate increase in the erection apparatus and temporary stresses. Some of the members required three cars for their transportation, being supported on pivots on the end cars, so as to pass around curves, while the center car became merely a spacer. Some pieces were too wide and high for clearance when loaded on ordinary cars, for which also their weights were too great. The railroad company designed special steel cars with distributing girders and open floors through which some of the heaviest pieces can be suspended. None of the very large or wide members were finally designed until after approximate sketches had been submitted to the railroad company and assurance had been given by them that they could be transported, after which they were designed to conform to any necessary modifications required.

Contrary to European practice, but conformable to the custom in American bridge shops, none of the principal members will be assembled and no part of the structure will be erected at the shops, complete reliance being placed on the accuracy of the design and workmanship and on the repeated inspections and careful clearances allowed. Riveted splices and main connections will have their field rivet holes drilled to cast iron templates and all splice plates will be shop fitted and marked. Great care was taken in locating the 500,000 ⅞ and 1-in. field rivets so that they can be advantageously driven with standard and special pneumatic hammers, and where this was impossible turned bolts are used instead. At first there were about 20,000 of the latter required, but eventually, by using special air riveters, this number was reduced more than 50 per cent.

Precise graphical and analytical calculations of camber and deflection under all practical conditions have been made, falsework has been proportioned to be free from settlement and as erection adjustments of ample magnitude are provided for making the final connections between the two sides of the bridge, it is not anticipated that there will be any serious difficulty in assembling and connecting the great trusses. The distances between pier centers have been repeatedly measured directly and checked by triangulation and the work has been built in the shops to steel measuring bars standardized by comparison with the units used in the field, with careful precautions taken to allow for temperature variations. It is therefore expected that all the center lengths of principal members will be accurate and as pins and joints are finished to 1/64 in., all pieces, even the last in the closing panel, should fit exactly, as received from the shops.



Erecting Wooden Falsework with Traveler [illegible]



Erecting Approach Span.

Comparison With Other Bridges.—Excepting suspension bridges, the longest of which is only 1,600 feet span, the longest span bridges yet completed are the double track Forth railroad bridge with two 1,710-ft. spans weighing 11,575 tons each and costing about $16,000,000; the 820-ft. single track Lansdowne bridge, India, the 812-ft. double track span of the Monongahela River bridge, Pittsburg, and the 790½-ft. span of the double track bridge across the Mississippi River at Memphis. All of these bridges are cantilevers with suspended center connecting spans, but none of them are comparable with the Quebec bridge, because, except the Forth bridge, their span lengths are not one-half that of the Quebec bridge.

The Memphis and Monongahela bridges are similar to the Quebec bridge in that they are pin-connected structures, built wholly at the distant shops and having their members shipped complete and swung to place and supported by traveler derricks until self-sustaining, in the characteristic American method. The travelers erecting the Monongahela bridge were of a similar type to that designed for the Quebec bridge and some of the special appliances and methods of work were similar, but as the former span weighed only about 14,000,000 lb. and cost $800,000, including substructure, the analogy cannot be very closely followed.

The only resemblance between the Forth and Quebec bridges is in their dimensions, they differ radically in their design; the former has riveted connections with indeterminate stresses, inclined trusses, tubular main members built up piecemeal in the field and built in special extensive shops temporarily established at the site. The Lansdowne bridge also has riveted connections, inclined trusses, huge members built up in the field, and was erected by an elaborate, complicated and inexact method of cableways, falsework, cantilevering and floating supports and falsework span, not wisely to be repeated.

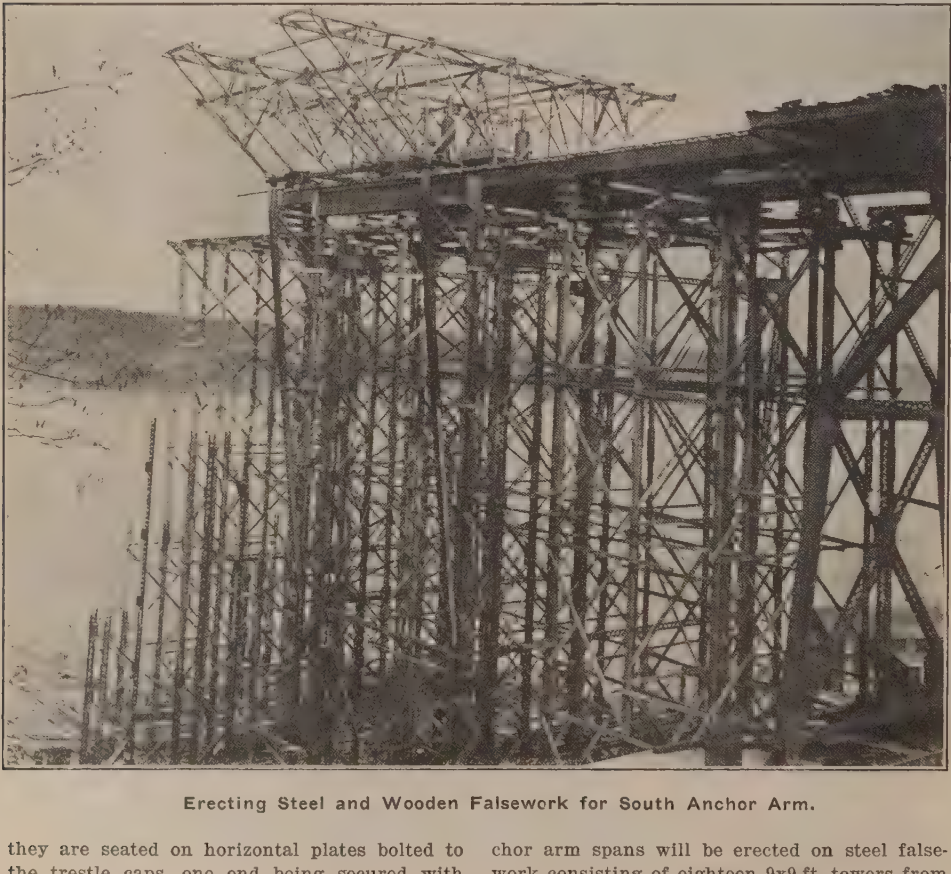
The only really comparable erection work is that of the 1,182-ft. span of the Blackwell's Island Bridge, New York, which although designed for much heavier traffic, weighs considerably less than the Quebec bridge span, but has members of nearly equal weight and length and will be erected, as described elsewhere in this issue, by methods very similar to those adopted for the Quebec bridge. The erection problems for both bridges have been worked out independently by different engineers and the work will procced simultaneously so that no precedent is afforded for either.

General Erection Scheme.—The superstructure of the Quebec bridge will be erected by the usual cantilever method common for large spans in America, the anchor arm spans being assembled on shore falsework and the river cantilever arms, with halves of the center suspended span built on to them continuously, erected as cantilevers without falsework, by a traveler with an overhang sufficient to assemble one panel in advance of its base. The south anchor arm, south river cantilever and south half of the center span, and the north anchor arm, north river cantilever and north half of center span will be successively erected with one traveler and one set of falsework which will be transferred from the south to the north shore of the river as soon as the erection is completed of the south half of the superstructure. The most important features of the erection will be the methods of handling and storing the steelwork, the use of steel falsework, the design and dimensions of the steel traveler which will have the unprecedented height of 212½ ft.; the elimination of steam and use of electric power for the operation of all power plant; the use of specially designed electric hoisting engines and the design of many special pneumatic and hydraulic tools for different parts of the work.

Materials will be delivered by rail in about equal quantities on both sides of the river at yards each of which will be equipped with two 60-ton, 68-ft. girder cranes with a clearance of about 30 ft. above the ground which travel on a 750-ft. runway with 36½-in. plate girders 60 ft. long, supported on four-post timber trestle bents 30 ft. apart. The cranes are made by the Phoenix Iron Co. and are each equipped with three electric motors made by the General Electric Co., which operate them at ordinary full load speeds of 8 to 15 ft., 75 to 100 ft., and 150 to 200 ft. per minute for hoisting, traversing and locomotion, respectively. The runway girders have no lateral bracing but are stiffened transversely by a 15-in, reinforcing channel on the upper flange and by the kneebrace plates with flange angles, which are anchored to the trestle caps.

The runway girders are made long enough to be used after this erection, for regular service in the shipping yards of the Phoenix Iron Co., and as the Quebec loads are much greater than those for the future service they are intermediately supported. At their end bearings they are seated on horizontal plates bolted to the trestle caps, one end being secured with bolts through holes slotted to permit temperature movements. The first and second, eighth and ninth, sixteenth and seventeenth and twenty-fourth and twenty-fifth bents of runway trestles on each side of the yard are X-braced longitudinally to form towers; all other panels are unbraced. Each trestle has two 12x12-in. sills, about 25 ft. long, transverse to the crane track, which give it sufficient bearing on the hard soil to prevent danger of settlement. The space between the trestles is covered with 12x12-in. transverse skids, supported in 12x12-in. longitudinal sills about 3 ft. apart on centers. The tops of the skids have light steel rails spiked to them to facilitate sliding the heavy members which are piled on them parallel with the crane track. Between the runway girders and parallel with them, are two standard gauge surface service tracks one of which receives cars from the railroad and the other is extended to the bridge about 3,500 ft. distant to deliver steel to its traveler. One locomotive and fifteen steel flat cars are provided for the yard service.

Erecting Runways for Girder Crane in Storage Yard.



Erecting Steel and Wooden Falsework for South Anchor Arm.

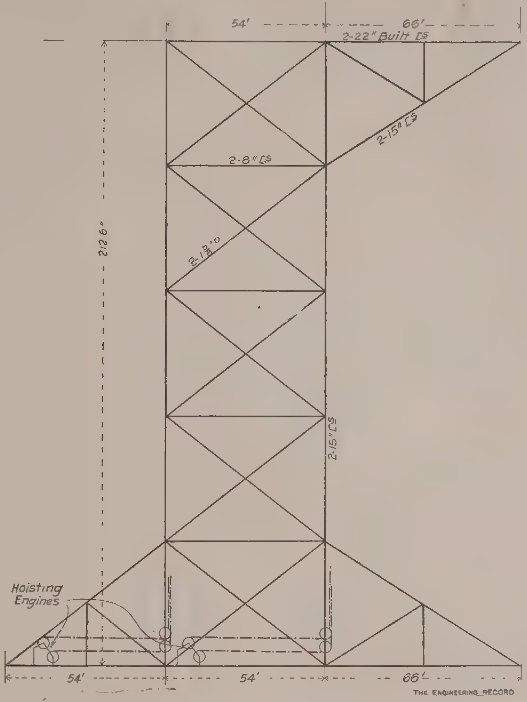
Steel Falsework.—The ten-panel 500-ft. anchor arm spans will be erected on steel falsework consisting of eighteen 9x9-ft. towers from about 127 to 160 ft. high, located at the panel points of the trusses. Each pair is braced together to make nine transverse bents, and the bents are braced by longitudinal horizontal struts and diagonal rods to make three 50x71-ft. single towers and one 100x71-ft. double tower, with three open panels between them. Each 9x9-ft. tower has four vertical posts made with a pair of 15-in. channels latticed and shop-riveted in three or four sections, field-spliced with four bolted splice plates. The four vertical posts are latticed together with 3x4-in. angles and each pair of them is seated on a transverse plate girder sill 27 in. deep and 16 ft. long. Both girder-sills for each tower are seated on 17x17-ft. grillages made with three solid courses of 12x14-in. planed timber drift bolted together and bedded on the levelled surface of the ground to which they transmit a maximum distributed load of about 3 tons per sq. ft.

The horizontal struts connecting the 9-ft. towers have at each end six turned bolts through reamed holes in jaw plates or gusset plates shop-riveted to the posts. The diagonal members are pairs of 3 and 5-in. eyebars engaging 3 and 4-in. pins through the reinforced cover plates of the posts. They are made in two lengths for each member and are connected at intersections by 3-in. pins with sleeve separators. The tops of the posts in each tower are connected by transverse plate girders riveted across their flanges and carrying grillages composed of nine 20-in. I-beams, 12 ft. long set close together to support the timber blocking 10 ft. high and 450-ton hydraulic jacks on which the lower chords of the trusses are seated.

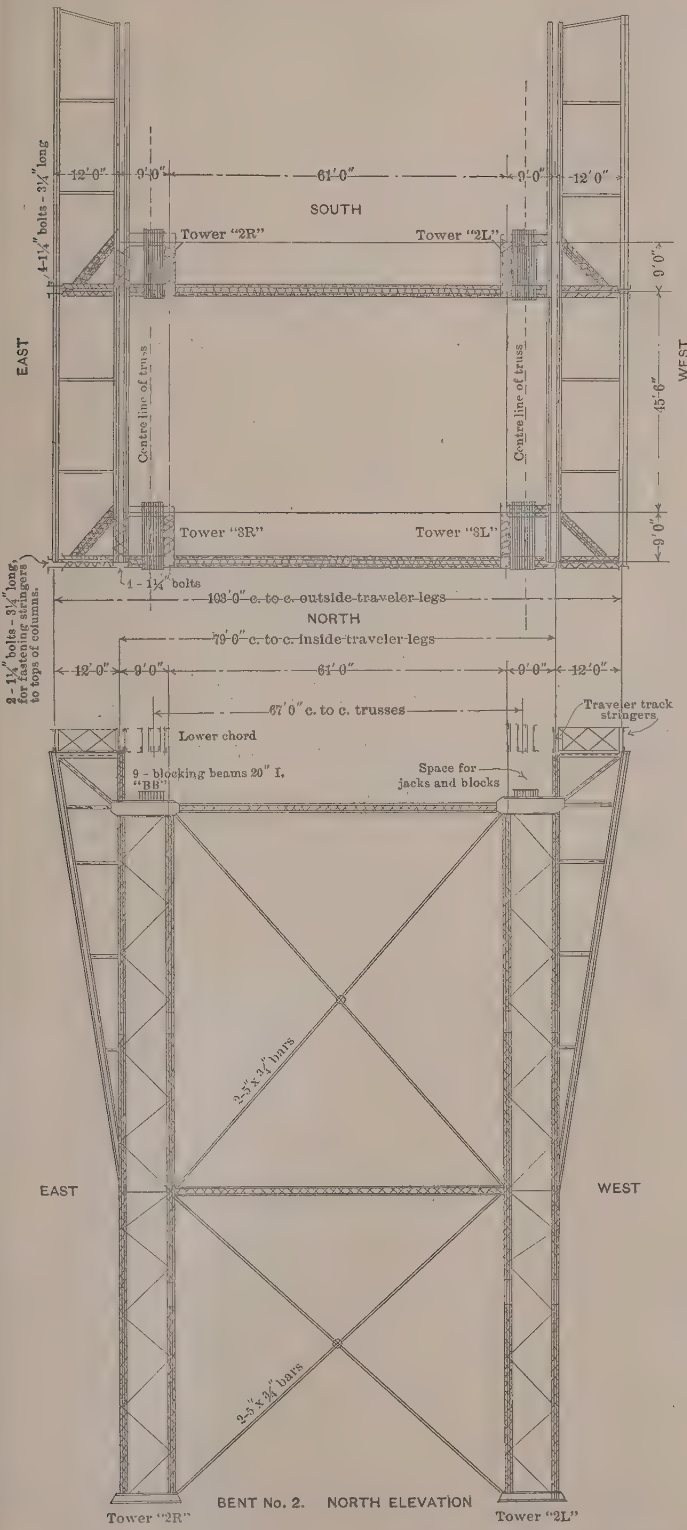
The two outside posts of each 9-ft. tower are carried from 10 to 80 ft. above the tops of the inside posts to help carry the two 12-ft. gauge traveler tracks 103 ft. apart on centers; their inner rails, on the center lines of the outside vertical tower posts have two plate girder stringers 58 in. deep; the outer rails have single duplicate stringers supported on inclined posts connected to the center points of the outside tower posts. The traveler track stringers are borrowed from the permanent bridge structure; 15 panels of them are used and are taken up from the rear and shifted around and laid in front as the traveler advances on the cantilever arm. The inside line is doubled to make it stronger than the outside line, in order to provide for the vertical stresses due to both traveler loads and wind, while the outer line provides for stresses due to wind alone. The inside posts have maximum computed stresses of 250 tons and 200 tons, respectively.

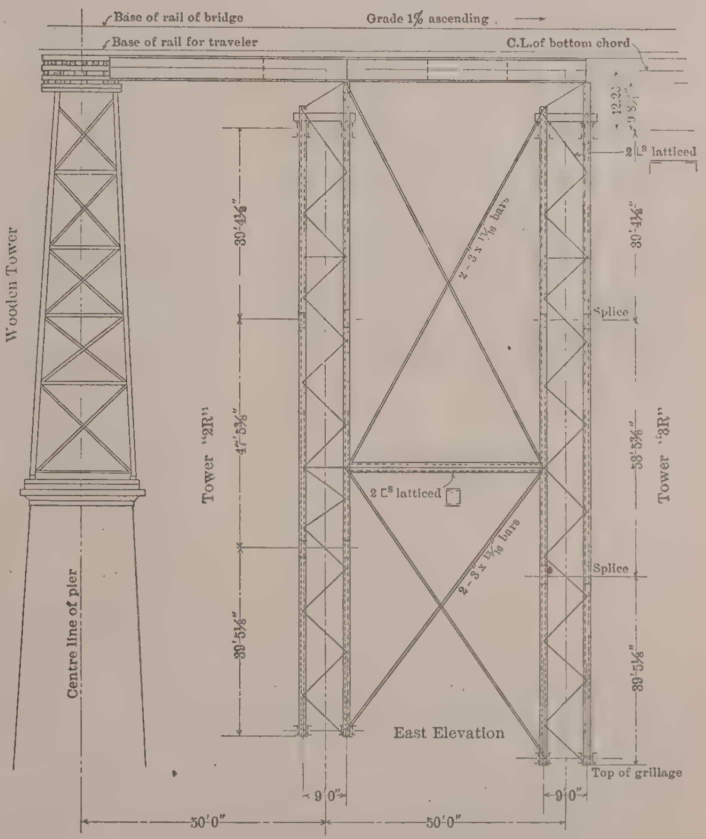
The traveler track stringers are secured by horizontal bolts through their end vertical web-stiffener angles and through vertical transverse diaphragm plates projecting for this purpose above the tops of the tower posts. A clearance of 2 or 3 in. between the stringer and diaphragm is made by inserting washers on the connection bolts. The total weight of the falsework is about 1,200 tons and it will be used on both sides of the river successively, changes of height being made by alterations of the lower sections of the vertical posts. As the traveler track is 110 ft. above the top of the anchorage pier masonry, pyramidal wooden towers about 21 ft. wide are set on the piers to carry the shore ends of the traveler track stringers.

Wooden Falsework.—The steel work will be delivered to the erecting traveler on two standard gauge tracks each 20½ ft. from the bridge axis, at about the level of the permanent bridge track which are carried by longitudinal plate girders borrowed from the permanent bridge stringers and supported on wooden falsework independent of the steel falsework. The wooden falsework has in each 50-ft panel of the trusses, one main and one secondary transverse bent from 132½ to 166½ ft. high spaced about 22 and 28 ft. apart to clear the steel falsework and the bridge members. The main bents, about 3 ft. from the panel points are made with five vertical posts in five or six stories from 24 ft. 9 in. to 27 ft. 9 in. high. The posts are spliced with butt-joints covered by pairs of 4-in. scab planks 7 ft. long with five bolts in each end. They are braced transversely with single 4x8-in. timbers as shown and have four or five lines of horizontal longitudinal 6x8 and 4x8-in. braces on each pier from end to end of the falsework according to height as indicated in the transverse elevation by the black cross sections.



Side Elevation of Cantilever Traveler.

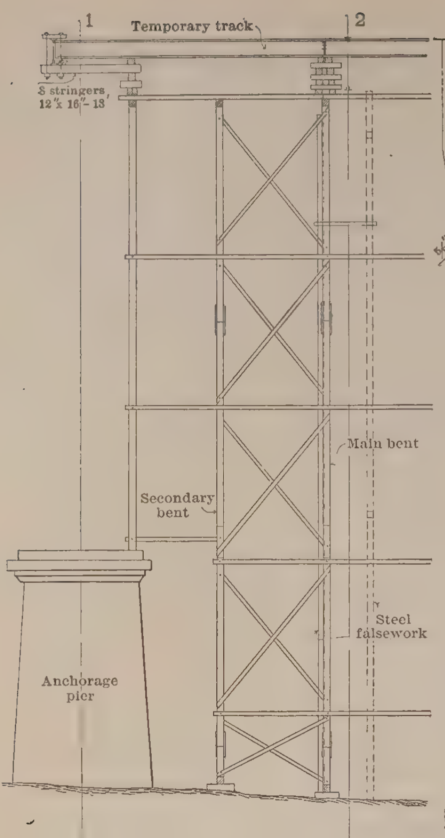


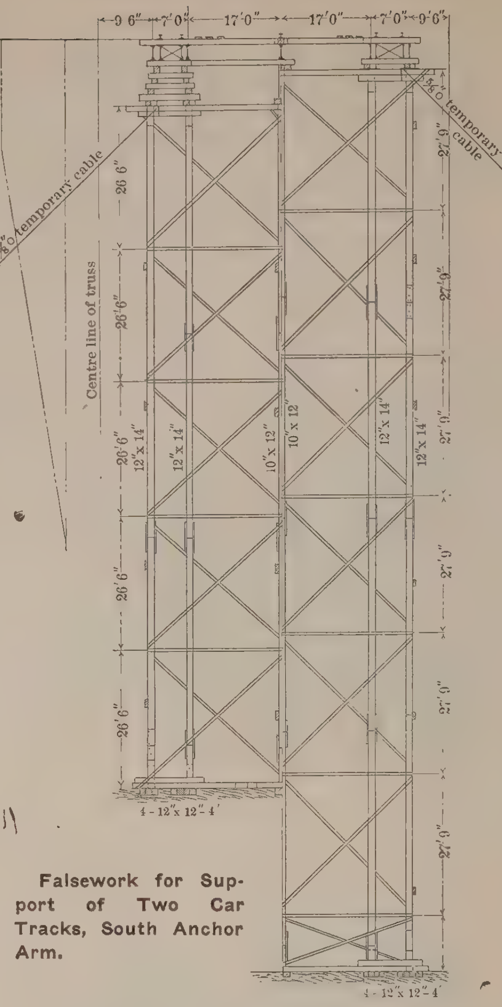


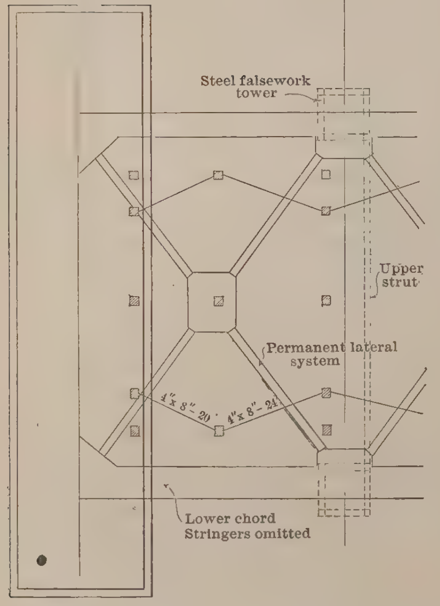
Plan and Elevations of Bent 2 of Steel Falsework for Shore Arms.

Alternate pairs of main bents are X-braced longitudinally across the intermediate bents to form alternating 50-ft. towers and open panels. The feet of the posts are scabbed to 12x12-in. full length transverse sills bearing on four longitudinal sills 3 ft. long under each post. The secondary bents correspond to the main bents except that the two posts next to the outside posts are omitted. All main bents are guyed on both sides by longitudinal ⅝-in. plough-steel wire cables until the steel falsework towers are erected when they are braced to them with clamped struts at the upper and middle points. The third and fourth bents from the anchorage pier were also temporarily guyed by ⅝-in. transverse lines from the ends of their caps while the traveler was supported on them erecting the adjacent steel falsework towers.

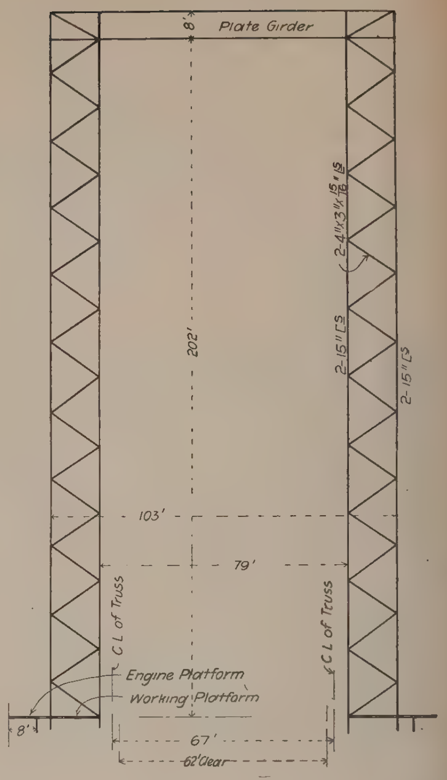
The falsework traveler was erected on the permanent track on the approach span with gin-poles and derricks. The caps of the bents







Falsework for Support of Two Car Tracks, South Anchor Arm.



Front Elevation of Traveler for Cantilevers.

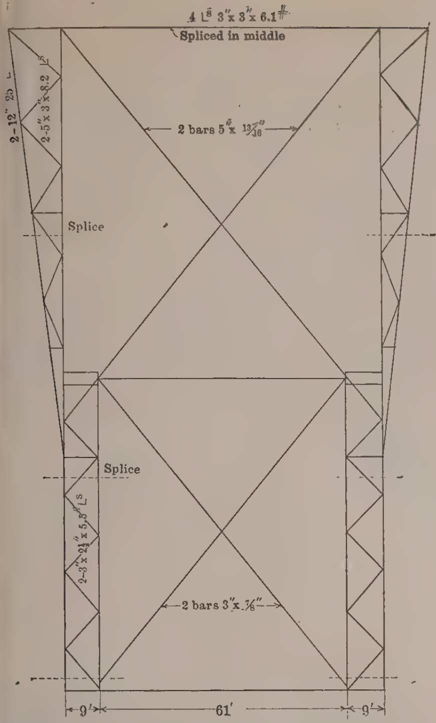
nearest the anchorage pier are about 6 ft. lower than those of the remaining bents and cribwork is built up on them to support the 3-ft. stringers under each of the five rails of the traveler tracks. These are borrowed from the permanent bridge floor and those in adjacent panels are bolted together through their end vertical web-stiffener or connection angles. At the shore end the first falsework bent is 10 ft. from the pier center to give clearance for the main pedestal and end post and the end stringers project beyond it and are supported on a set of wooden longitudinal girders seated at one end on the bent-cap and at the other end suspended from the end floorbeam of the approach span. In order to secure full bearings for the ends of the track stringers on the falsework caps and to avoid cutting them, the pairs for consecutive panels are braced together 5 ft. and 7 ft. apart on centers so that they may be set on the same center line and level with their ends overlapping and have clearance.

Travelers.—The traveler for erecting the falsework is about 100 ft. long and 116 ft. wide on top and 30 ft. high over all, made entirely of timber and is mounted on twelve double-flange wheels running on three single lines of rails, one in the bridge axis and one 23 ft. each side of it, the latter two being the outer rails of the two material tracks. There are three full-length main longitudinal trusses 23 ft. apart on centers which overhang the centers of the forward wheels about 44 ft. and support transverse beams on their upper chords from which the erecting tackles are suspended. There are also two pairs of transverse trusses about 116 ft. long over all which overhang sufficiently to erect the outside posts of the steel falsework towers. The sills are pairs of 6x12-in. timbers and most of the other principal members are made with single squared timbers 6, 8 and 10 in. wide, connected with scabs except at a few important points where they are bolted between pairs of ⅜-in. steel connection plates. The top and bottom chords of the transverse trusses are pairs of 6x12-in. pieces and the lateral diagonals are made with single 3 and 4-in. pieces. A plank floor is laid on the sills in the rear of the traveler and on it are seated two double-drum, four-spool hoisting engines.

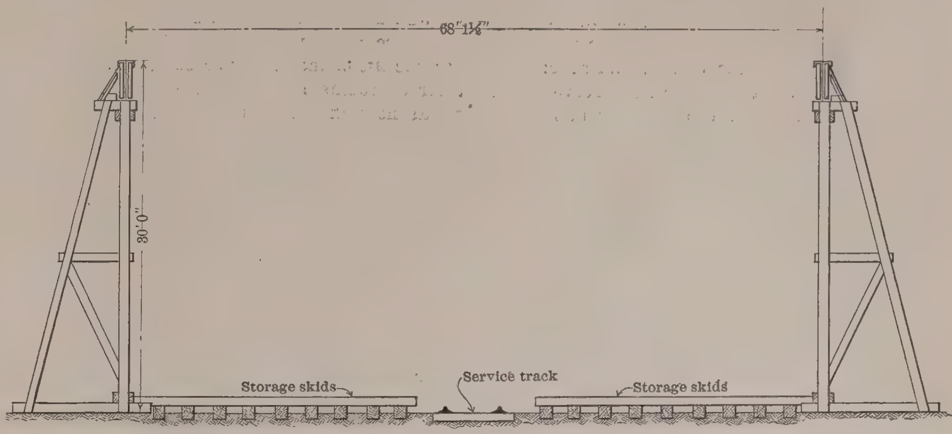
After the falsework for the south shore anchor arm span has been completed the wooden traveler will commence on it the erection of the 450-ton steel tower traveler for the erection of the permanent superstructure. After the lower part of the tower has been erected by the falsework traveler the latter will be removed and the upper part will be erected by gin-poles and derrick booms carried up on the steelwork as the latter is assembled. The steel traveler is designed to erect all of the 80,000,000 lb. of steel in the three spans with their continuous trusses 2,800 ft. long and 315 ft. high, and will run from anchorage to anchorage on them at roadway level 120 ft. above the main pier tops and about 160 ft. above high water level. It is designed to assemble 100-ton members nearly 100-ft. long, in a structure over 300 ft. high, to swing them far beyond the supports of its own base and to maintain and adjust them in mid-air until self-sustaining. It therefore has unprecedented capacity and dimensions and, like the steel falsework has been as carefully calculated and designed, and has been made from as high grade steel, with as accurate shop work and careful inspection as any first class permanent bridge order executed in the Phoenix shops.

The traveler consists of a 54x103-ft. tower 212½ ft. high, mounted on 24 double-flange wheels, and having a 54-ft. cantilever rear extension at the base to counterbalance the 66-ft. cantilever trusses projecting from the top and bottom of the traveler on the front side to support the tackles and workmen for erecting one panel of the main truss in advance. In order to secure increased lateral stability and to avoid obstructions from the transverse bracing between the trusses the traveler is of the striding or gantry type, running over and outside of the trusses and therefore free to move back and forth at any stage of the erection. Its tower is made with two transverse bents each of which has four vertical posts united only by a deep overhead horizontal plate-girder. The inside posts are intended to carry all the weight from members suspended in the tackles, and may have maximum loads of 450 tons each. They are each supported on a four-wheel truck on a 30-in. gauge track. The outside posts are loaded chiefly by wind stresses and may have a maximum computed stress of 170 tons, carried by a two-wheel truck running on a single rail.

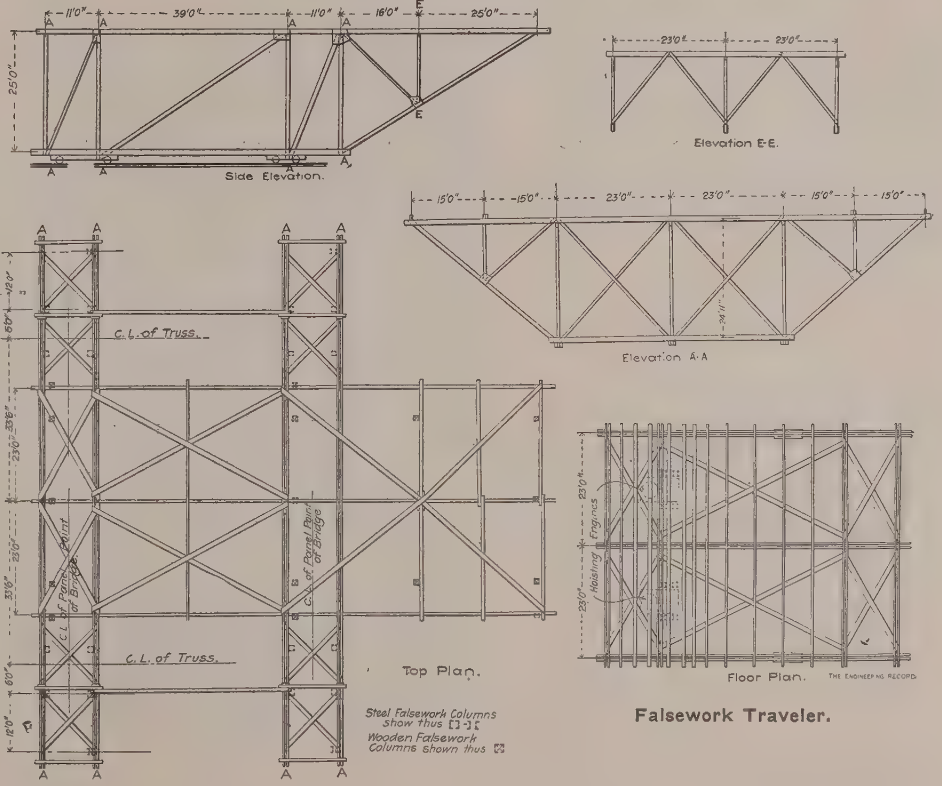
As the track grade varies, verticality of the posts is secured by interposing movable shim plates between the feet of the rear posts and their trucks. The feet of the forward posts and the extremities of the rear cantilever are anchored, when the traveler is in service, by pairs of vertical screw rods engaging the ends of transverse yoke-beams bearing on the under side of the track-stringers. The sills between the feet of the tower posts support transverse floorbeams and cantilevers on which there is a platform built, about 20 ft. wide, clear of the



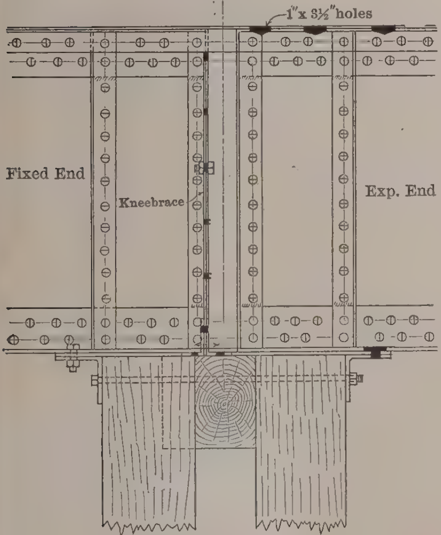
Section of Bent 10, Steel Falsework for South Arm.

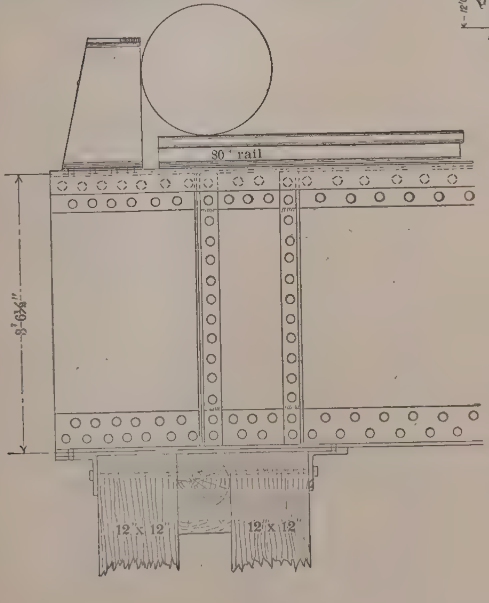


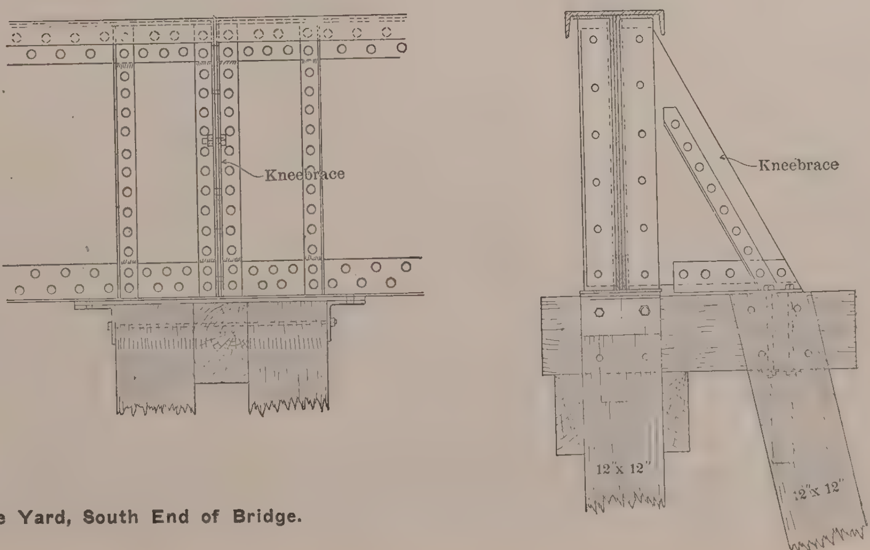
Cross-Section of Storage Yard.



Falsework Traveler.







Girders of Runway for Storage Yard, South End of Bridge.

trusses on both sides of the bridge, for the hoisting engine, supplies, storage, etc. These platforms are continued on the front cantilevers and there afford working scaffolds for the erectors. The transverse girders of the upper cantilever trusses support a longitudinal box girder in the plane of each truss, a plate girder stringer in the axis of the bridge, and several intermediate transverse beams which serve as jigger beams from which the erecting tackles are suspended. There is a system of X-brace diagonal lateral angles in the plane of the top chords of the upper cantilever trusses and in the planes of all the horizontal struts and sills of the tower posts. With the exception of the pin-connected diagonal rods in the sides of the tower, all the tower members are connected with turned bolts through reamed holes in cover or jaw plates, thus facilitating the taking apart and reassembling of the traveler when it is moved from one side of the river to the other. About 60,000 turned ⅞-in. bolts are required for the field connections of the traveler and the steel falsework.

Tackles.—From the box girders in the top of the steel traveler there will be suspended eight 13-part 55-ton tackles each having about one mile of ⅞-in. plough-steel cable rove through special steel blocks with six 20-in. sheaves. The lower blocks are 4 ft. long, 30 in. wide and 21 in. thick with solid cast-iron filler plates between the steel cheek plates to increase the weight to about 5,000 lb., and cause it to overhaul positively and quickly without the addition of loose weights. It is connected to a heavy shackle with forked ends giving four bearings on the 3 7/16-in. pin through the upper part of the cheek plates, and diminishing the bending moment on the pin. For handling secondary and transverse members the traveler is also provided with eight 25-ton and twelve 10-ton manila tackles with wooden blocks rove with manila line and suspended from the center and intermediate jigger beams in any required position.

Hoisting Engines.—The steel traveler is equipped with four special, 20-ton electric hoisting engines designed and manufactured by the Lidgerwood Mfg. Co., in accordance with the requirements for this work as specified by the contractors, engineers and superintendent of erection. The engine, including the 115-h.p. General Electric motor No. 55, by which it is operated, weighs about 25 tons and occupies a space about 14 ft. long, 12½ ft. wide and 7 ft. high. It has two drums and four spools, the former being fitted with V-band brakes and designed to accommodate 4,500 ft. of ⅞-in. wire cable. The spools are keyed on the shaft and their gear-wheels run loose on the shafts, being continuously driven and avoiding the great loss of power which is occasioned in some engines by the shafts running loose in dead spools under heavy stresses. The spools engage steel clutches with square jaws which are provided with special devices to prevent them from becoming accidentally disengaged. The ratchets and pawls and all gear-wheels are made of cast steel and are shrouded to the pitch line. The drums and spools are connected by eccentrics and links to their operating levers arranged all together in quadrant frames side by side at the rear of the engine near the controller box, so that the engine man can command all operations without moving from one position. The drums are geared 26½ to 1, and can wind up 100 ft. of line per minute under a tension of 33,000 lb. The spools are geared 12.3:1 and can wind up 150 ft. of line per minute under a tension of 15,000 lb. Two of the engines are made with changeable speeds so that light loads can be hoisted much more rapidly than heavy ones. Besides these engines eight other standard four and six-spool hoisting engines will be used on this work to operate the falsework-erecting traveler and for other purposes.

Special Tools.—Special hydraulic rams operated by electrically driven pumps will be provided for driving the truss pins which, excepting those in the main pedestals do not generally exceed 14 in. in diameter and 10 ft. in length on account of the special feature of double connections at panel points. Pneumatic hammers, drills, reamers, chisels and other tools, many of them of special design, will be operated by air at 100 lb. pressure from either of two interchangeable Ingersoll-Sergeant compressors which will be driven by an electric motor. An electric light plant will be established and machine shops and blacksmith and woodworking shop and saw mill have been installed with machinery operated by electric motors. An electric sub-station has been established at the storage yard, another will be at the south end of the bridge and eventually, a third at the north end. All power will be derived from electricity from the Chaudiere Falls power plant of the Canadian Electric Light Co., and the use of steam will be entirely eliminated on the work.

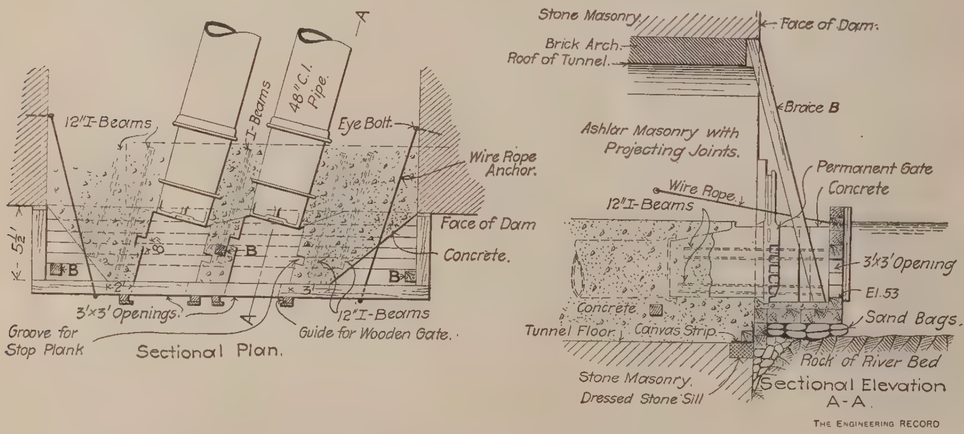
The bridge will be owned by the Quebec Bridge Co., Limited, for whom Mr. E. A. Hoare is chief engineer and Mr. Theodore Cooper, consulting engineer. The contract for the steelwork and its erection was awarded to the Phoenix Bridge Co., of which Mr. David Reeves is president and Mr. John Sterling Deans, chief engineer, Mr. P. L. Szlapka, designing engineer and Mr. A. B. Milliken, superintendent of erection.

Municipal Construction of all public works in Manchester, England, is being investigated by a special committee of the city council.

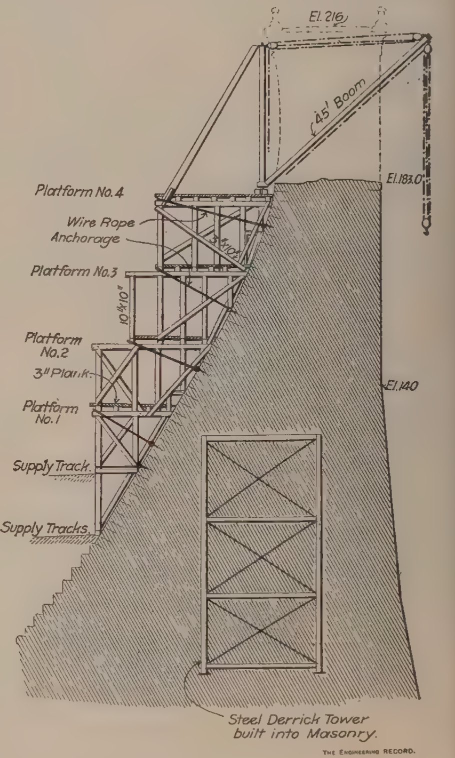
Completing the New Croton Dam.

When the lower part of the masonry in the New Croton Dam was built, a tunnel was left in the north end to provide for the passage of the normal flow of the Croton River. It was about 150 ft. long, 28 ft. wide and 20 ft. high at the upper end and tapered to 16 ft. high and 20 ft. wide at the lower end. The invert was at elevation 149 and the roof was lined with a 24-in. brick arch made in five equal panels offset 12 in. in transverse vertical planes to make steps to key against the filling masonry when it should be laid and afford resistance against pressure from up-stream. Similar offsets were also made in the same planes in the side walls and the stone masonry is laid with the vertical corners of the heavy blocks projecting upstream at an angle and the bottom was made intentionally rough, for the same purpose. About 75 ft. south of this tunnel a similar one was left to provide a passage through the incompleted dam for the flood discharge of the river. It was about 100 ft. long, 20 ft. high and 22 ft. wide at the upper end, 18 ft. high and 18 ft. wide at the lower end, with the invert at elevation 160. When the dam masonry reached a suitable height to enable the impounding of water it was intended to close both tunnels with concrete, brought in from the up-stream side and filled in from the lower to the upper end, and to face the up-stream end of the river tunnel with ashlar masonry corresponding to the adjacent face of the dam.

When the masonry of the extension at the south end of the dam, which was the last portion to be built, reached elevation 180 operations were commenced to close the river tunnel. At this time, December, 1904, it was in the dry season and only a small volume of water was flowing through the tunnel and provision for it was made by building a temporary low wooden cofferdam to close the upper end of the tunnel and admit the water to a pair of permanent 48-in. cast-iron waste pipes with gates outside the tunnel on the up-stream ends commanded by vertical rods operated from a platform submerged when the reservoir is full. Gates will also be placed on the lower ends of the pipes



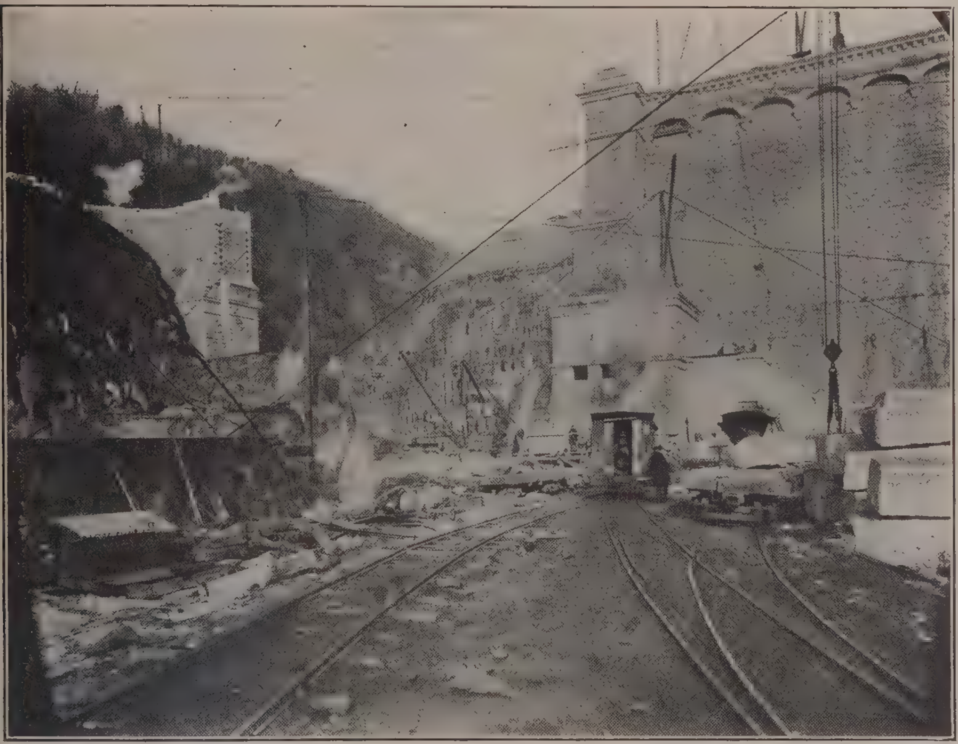
Cofferdam at Upper End of River Tunnel, Croton Dam.



Falsework Platforms.

in chambers built in the dam masonry, under the spillway, and there will be the usual provision for stop planks auxiliary to the gates.

Across the upper end of the tunnel floor a 12x12-in. timber was laid with a strip of canvas for a gasket, on the dressed surface of the masonry and secured by anchor bolts. To it three courses of 12x12-in. parallel timbers were bolted outside, making a vertical wall up to the under side of the cast-iron pipe fittings which projected over and beyond them. To clear these the cofferdam was continued up-stream by a horizontal floor platform of 12x12-in. timbers bolted together and connected at the upper end to the lower edge of a vertical wall of nine solid courses of 12x12-in. timbers, the whole forming a dam, Z-shape in cross-section and nearly 11 ft. high. All the timbers were planed and their joints made with white lead. Sand bags and clay were packed under the horizontal apron of the dam, and it was braced against the bouyant effect of the 2 ft. of water in which it was built by three inclined timbers against the roof of the tunnel portal and anchored back by wire ropes attached to eyebolts in the side walls.



North End of Dam; Spillway and Flood Tunnel.

One of the pipes was laid in the tunnel with its lower side at elevation 153 and supported by timber frames under each bell. A 20-in. service track was laid on top of the pipe and concrete was delivered by a Petler dump car from a mixer on the down-stream side of the dam and spread over the bottom of the tunnel. When it was concreted to the bottom of the pipe the other pipe was laid directly on the concrete, without the use of timber supports which in the case of the first pipe were permanently built into the concrete. The concrete was filled in up to the tops of the pipes, completely enclosing them at the upper end as a precautionary measure which proved entirely efficient when the pipes were soon after entirely submerged by a freshet which rose over the top of the cofferdam but did no damage.

The original intention of filling the tunnels from the upper ends contemplated the execution of that work during the summer, in time of low water, when there was little danger of floods likely to interfere with the work. It became necessary to close them in the winter when melting snows might produce serious sudden floods and it was considered best to modify the plan by closing the upper ends of the tunnels first, thus immediately providing barriers against high water that otherwise might at any time stop operations and damage the work. Two vertical transverse bulkheads, about 5 and 10 ft., respectively, from the up-stream face of the dam were built and served as forms in which a concrete wall was carried up from the floor to the roof of the tunnel with concrete delivered from a cubical mixer on the down-stream side. The outer face of this wall was plastered with four troweled coats of neat cement mortar and washed several times with grout, applied with a broom, thus making it watertight.

Two feet of the outer end of the brick roof arch was then blasted away to make a better bond with the concrete which was filled in flush with the face of the dam in the space in front of the wall, thus modifying the original plan for a masonry surface there. As soon as the tunnel was closed tracks were laid in it from the down-stream end on a trestle about 8 ft. above the tops of the pipes and concrete was brought in and built up as rapidly as possible to afford backing for the wall. When a 40-ft. length had been built a warm rain fall of 3¼ in. on 8 in. of snow produced a sudden flood which raised the water 10 ft. above the tunnel roof without any injury to the concrete, the water escaping through the flood tunnel which had served a similar purpose for relief service half a dozen times in the three years since its construction.

The flood tunnel had been previously used for the passage of the material trains from the quarries and for ten days these tracks were out of service and supplies of ashlar and broken stone were cut off until a new high level track from the quarry which had been previously commenced on the north bank of the river at an elevation above that of the dam crest, was completed. When the water in the river subsided to its ordinary level it was all easily carried through the two pipes in the river tunnel and the floor of the flood tunnel being left dry its up-stream opening was closed by a wall of ashlar masonry with dressed beds and ½-in. cement joints. Materials for it were delivered through the tunnel from the down-stream end and the wall was built by one 8-hr. shift of masons and three 8-hr. shifts of concreters, the latter working night and day to back up the comparatively thin wall and reinforce it against pressure from a sudden flood.

As soon as the concrete in the river tunnel had been carried up to the tops of the pipes a concrete track was built 5 ft. below the roof on a timber trestle and from it concrete was filled in up to track level in successive 10-ft. lengths from the upper end of the tunnel. As each length was completed two longitudinal bulkheads, 2½ ft. each side of the center line of the track, were built with 10-ft. lengths of horizontal boards added successively as the concrete was filled in behind them and retained by transverse bulkheads across the down-stream ends. This practically left the service track in a 5x5-ft. top heading which was finally closed up by concrete shoveled and rammed up to the roof in the front end, the men working backwards and closing up the space as they retreated. It was found difficult to pack in the concrete tightly at the top of the confined spaces and finally rubble stone masonry was substituted for the concrete in the upper part of the tunnel. This could readily be wedged and packed into place and was considered more satisfactory.

When the brick arch tunnel roof was built three horizontal 3-in. pipes were built into it parallel with the axis, from the down-stream end to each offset, thus making in the lower panel of the roof 12 pipes, in the next 9 and so on to the panel next the upper one, where there were only 3. As the concrete was filled in up to the roof in each panel, one-panel lengths of pipe were screwed to the projecting ends of these pipes where they pierced the vertical surfaces of the offsets, and were built into and supported by the concrete. These extensions of the pipes had three ½-in. holes every 5 ft. through which grout was to be forced from the down-stream end of the tunnel to fill any interstices and compensate for any shrinkage of the tunnel filling. After about 30 ft. of the upper end of the tunnel had been filled with concrete and it had set for 12 days, it was grouted under a pressure of about 100 lb. Some time later when the water rose to a height of 10 ft. above the tunnel floor it was apparent that further shrinkage had occurred and openings were developed through which a small stream of water penetrated. As the pipes for this part of the work were set full of grout, they were no longer available for further service and it became a difficult problem to provide compensation there and elsewhere for continued shrinkage, and at the same time to fill the interstices promptly before the concrete was thoroughly hardened.

The difficulty has been met by an ingenious method of stock ramming. In the middle of each of the remaining panels of roof arches a transverse channel is provided across the tunnel roof, into which the three 3-in. pipes open. These pipes will be filled with clay cartridges and after the concrete is sufficiently set, a locomotive on an elevated platform at the down-stream portal of the tunnel will ram a plunger in the pipe and force the clay into the chamber and beyond it into the adjacent cavities in the masonry. This operation can be repeated at any future time and thus can always provide compensation for continued shrinkage. No fear is entertained of inadequate penetration of the clay because recently when the contractors were stock-ramming the grout pipes extending through 60 ft. of the main dam masonry into the seams in the foundation to make a water-tight joint between old and new masonry, as described in The Engineering Record of Sept. 10, 1904, the 2,000-lb. hammer falling 10 ft. created such a high pressure in the 3-in. pipe that it burst a coupling in the pipe and the clay escaping penetrated between the courses of masonry, and although the stones were well set and bonded, lifted them ¼ in. near the pipe and ruptured the masonry for a radius of 30 ft., 5 ft. above the leak in the pipe, as described in Mr. C. S. Gowen's paper on the "Foundations of the New Croton Dam," transactions A. M. Soc. C. E., Feb. 21, 1900. About 4,000 yd. of masonry is required to fill both tunnels and over half of it has been laid since Jan. 1, 1905, by a total force of about 25 men, exclusive of those at the quarry and handling trains, etc., but including those operating the concrete mixer. This is the only masonry laid during the extreme cold weather, and it was then protected by large pieces of heavy canvas spread over the top of all new work and closely secured around the edges. It is raised a few inches above the surface of the concrete and supported on light timbers and blocking so as to provide spaces above the concrete in which the confined air is warmed by live steam throttled down and discharged from the ends of steam hose about 25 ft. apart, supplied from a 3-in. main receiving steam at a pressure of about 90 lb. Several watchmen are kept on duty all night to see that the apparatus is in good order and the temperature is kept at 70 to 90 deg. in the coldest weather. In the morning the surface of the concrete is invariably found dry and warm, the condensation water having all been absorbed by the concrete. The canvas is kept over the concrete and steam turned on at night and during cold days until it is two or three days old except when it is removed at points where the men are working. The concrete is made 1:2:4 with Giant Portland cement and 2-in. broken stone, mixed very wet, and about 1 lb. of salt per gallon is added to the water used in mixing in weather when the mercury is more than 15 deg. below freezing. Concrete for the tunnel and for the masonry on the extension of the main dam is mixed in two Carlin's cubical mixers and in three Ransome drum mixers, all supplied with materials delivered by gravity from the storage bins and located as described in The Engineering Record of July 9 and September 10, 1904, in which the work on the lower part of the extension was illustrated.

The extension, as will be remembered by many readers, is a masonry structure about 300 ft. long, 200 ft. wide at the base and 200 ft. high, corresponding in cross section and construction to the main dam and carefully bonded to its southern end to replace the earth dam with a rubble core wall with which it was at first intended to join the main body of masonry to the side of the valley. About 80,000 cu. yd. of masonry have been laid in this part of the structure during the past season under many disadvantages incident to the dimensions of the masonry and the narrow accessible spaces around it in which to handle materials and to prosecute the excavation and back filling. Materials have been delivered by cableways and by standard-gauge service tracks laid on the back-fill, on berms of the excavation and on trestles at elevations 90 and 115.

As many as eighteen stiff-leg and guyed derricks have been set on the lower part of the masonry so as to command all parts of it and as many as 8 mason gangs have been simultaneously at work on the lower part of the masonry. When it had risen to elevation 80 two permanent steel towers 50 ft. high were established on the top of the masonry and four 60-ft. boom derricks on each handled the work until about the first of last October when it was completed to elevation 133 just above the tops of the towers which were then sealed in the heart of the masonry.

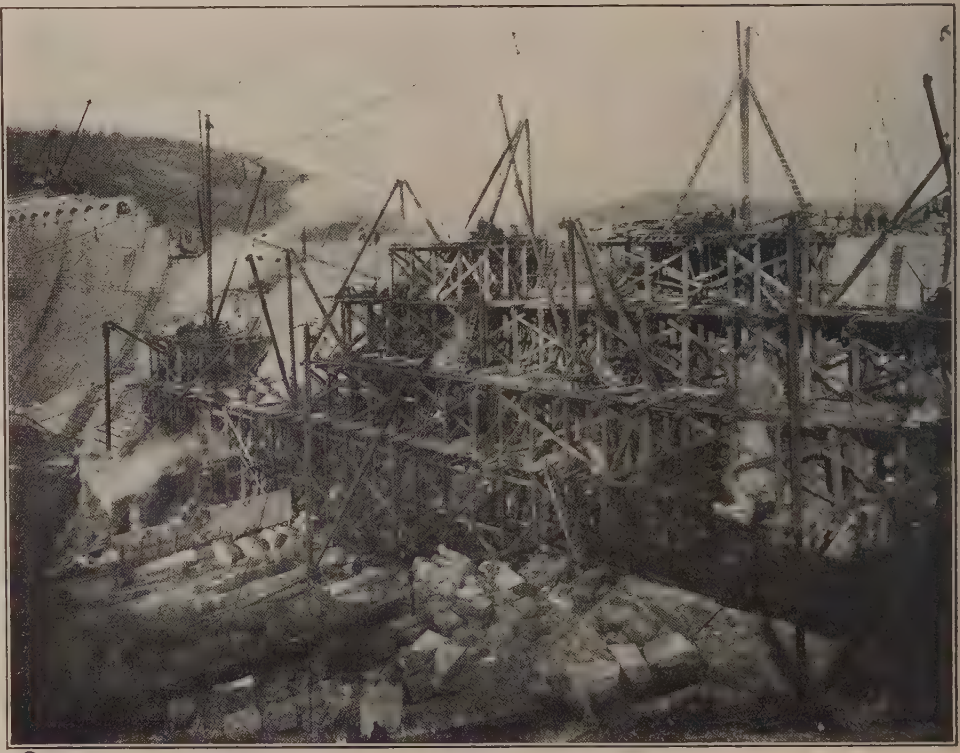
Their derricks having been removed a timber platform 20 ft. wide was built alongside the down-stream face of the dam at elevation 133 and supported on trestle bents seated on the offset courses of the sloping face and anchored to the dam by wire ropes as indicated by the cross-section. Loops were made of 8 or 10-ft. pieces of old guy ropes and were laid horizontally on top of the face stones and built into their joints as the work progressed. They were arranged so that the bight projected a few inches beyond the face of the dam and the ends diverged at about 90 deg. from each other. The bights served as eyes through which the anchor ropes were looped and clamped. On this platform six derricks were set and materials were handled and received for the building of the masonry up to elevation 148 when a second-story platform was added and all but the two end derricks were moved up on it and the masonry was built up to elevation 163 when a third platform was added, the derricks moved up again, the masonry continued to elevation 180 and a fourth platform added, as shown in the accompanying photograph. From this platform the masonry will be built up to about elevation 195 and the remaining 21 ft. will be handled by two stiff-leg traveling derricks which have been already installed on the completed portion of the dam to build the crest masonry, the front arches and the parapets.

About 15,000 yd. of masonry remains to be built, but work on it has been suspended during the coldest weather. At first the work was commanded by three 1,500-ft. cableways of about 1,500 ft. span which were installed by the Lidgerwood Mfg. Co. and the Trenton Iron Co., and were used for delivering supplies to the masons and for moving derricks, machinery, etc. When the masonry reached elevation 130 the cableway directly over top of dam became useless on account of insufficient clearance and was removed, the easterly cableway was taken down shortly after, but the cableway on the down-stream side of the dam being clear of the masonry is still in service, unloading quarried and broken stone from the high level supply tracks on the north side of the valley, shifting derricks and erecting the falsework.

The large stone is delivered by the cableway directly to the working platforms and thence handled by the boom derricks. Broken stone is chuted down the north side of the valley to low-level cars which deliver it to the concrete mixers and the concrete is now taken on narrow-gauge cars to the foot of the trestle and thence hoisted to the top of the masonry by the derricks. The derricks have booms 40 to 60 ft. long, most of them of 10 tons capacity, and are operated by double-drum hoisting and swinging engines of Lidgerwood and Mundy manufacture, supplied with steam from the central boiler plant.

The work has been so much expedited by the installation of the trestle platforms that the masonry was finished on Dec. 31, 1904, to elevation 180, and it was considered safe to commence impounding water in the reservoir, a consummation for which the chief engineer and contractor had been making most strenuous efforts. A great advantage of the platforms was that the masonry could be built in continuous courses the full length of the extension, and not interrupted by the racked-off summits necessary when the derricks were seated on the masonry. During the last summer the force employed on the dam was 350 men and 250 in the quarry. At present there is a total force of about 250 men employed by the contractor, half of them in the quarries. The prospects are that unless unforeseen delays occur the dam will be practically finished early in the present season.

Mr. J. Waldo Smith is chief engineer, Mr. Chas. S. Gowen, resident engineer, and Messrs. Coleman, Breuchaud & Coleman are the contractors, for whom Mr. J. B. Goldsborough is superintendent. The work done by them on the dam last year is one of the best records of progress of its kind.



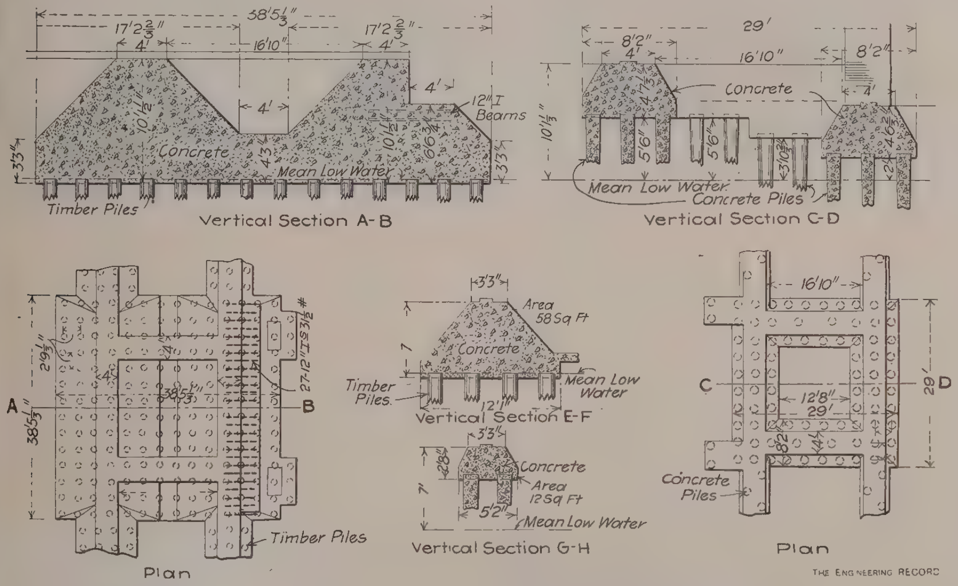
Falsework Platforms and Derricks at South End of Dam.

Concrete Piles at the United States Naval Academy.

By Walter R. Harper, Inspector in charge of the Academic Group, U. S. Naval Academy.

After the value of an efficient navy was made evident by the war with Spain, Congress made appropriations, from time to time, amounting to $10,000,000, to rebuild the Naval Academy at Annapolis, Md. The plans of Mr. Ernest Flagg, architect, of New York, were selected for the new academy. These plans contemplated a new sea wall, armory, seamanship building, midshipmen's quarters, gymnasium, hospital, chapel, officers' quarters, officers' mess building, steam engineering building, power house, and academic group.

The academic group, the foundations of which are the subject of this article, consists of the library building, of granite and brick, about 150x133 ft., three stories high, with a central tower about 140 ft. in height containing a revolving dome for astronomical work. On one side of the library is a wing known as the physics and chemistry building, and on the other the academic building. These two wings are also of granite and brick and nearly of the same design, three stories in height, and about 229x84 ft. each. This group, taken as a whole, is one of the largest buildings in the country devoted to educational purposes.



Comparative Sketches of Timber and Concrete Piles, Tower Foundations.

The soil on the site of the physics and chemistry building was of such a nature that piles were not required, but they were necessary under both the library and academic buildings, a portion of this land having been reclaimed from the Severn River by filling with sand and mud by means of dredges, three years previous to the beginning of these foundations.

Certain amounts of the appropriation were allotted to the various buildings. When the bids for the academic group were opened, the lowest, that of John Peirce, of New York, was found to far exceed the $1,500,000 allotted for the group, and some method had to be resorted to which would reduce the cost and still preserve the general plans of the buildings. Concrete piles were suggested, and upon investigation it was found that by their substitution for the wood piles shown in the original plans, the cost could be reduced about $27,000. Owing to the fact that wood will decay rapidly if not permanently covered with water, it is necessary to cut wood piles off at mean low water, and the concrete footings must start from this point and be carried up to the height of the bottom of the walls. With concrete piles, the tops are left just far enough below the bottom of the walls to allow for a concrete beam thick enough to carry the weight of the building.

This difference in thickness of concrete footings is well illustrated by a section of the footings of the academic building with wood piles and the same section as redesigned and built with concrete piles. This saving in excavation and footings depends upon the height of the building above mean low water. At the Naval Academy the rise and fall of the tide in the Severn River is very slight, consequently the buildings have been placed only a few feet above mean low water. Notwithstanding that the cost per lineal foot for concrete piles far exceeds that of wood piles, being about four times as much, the saving in the entire foundation by their uses will surprise the uninitiated, as will be seen by a glance at the cuts shown here.

In the accompanying diagrams the section E-F shows the footing of the connection between the library and academic building as designed by Mr. Flagg for wood piles. Another sketch shows the same section, G-H in the diagrams, as built with concrete piles. The depth of footing on this section was reduced from 7 to 2 ft. 8 in., and the width on the bottom from 12 ft. 1 in. to 5 ft. 2 in. The area of the cross-section was reduced from 58 to 12 sq. ft. In the plan of the wood piles under the library tower there are 202 piles in a rectangle 38 ft. 5⅓ in. square. The plan of the same tower foundation with 84 concrete piles has footings 8 ft. 2 in. wide.

With wood piles it will be noticed that the piles and footings extend over the entire rectangle, while with concrete piles the piles and footings are only 8 ft. 2 in. wide and directly under the walls of the tower. The depth of the footing was reduced by the use of concrete piles from 10 ft. 1½ in. to 4 ft. 7⅓ in. Twenty-seven 12-in. 31½-lb. I-beams were done away with.

The following reductions on the foundations of the two buildings were made by the use of concrete piles: 2,193 wood piles were replaced by 885 concrete piles; 4,542 yd. of excavation were reduced to 1,038 yd., saving 3,504 yd., and 3,250 yd. of concrete footings were reduced to 986 yd., saving 2,264 yd.

With wood piles after excavating to mean low water, shoring and pumping would have been necessary in all trenches, and this saving was estimated at $4,000. A schedule of changes showing the saving by the use of concrete piles is given in Table 1.

Table 1.—Comparative Cost of Wood and Concrete Piles.

Wood Piles.			
2,193 piles	at $9.50	$20,835.50	
4,542 cu. yd. excavation.	" .40	1,816.80	
3,250 cu. yd. concrete...	" 8.00	26,000.00	
5,222 lb. I-beams	" .04	208.88	
Shoring and pumping		4,000.00	
Total cost			$52,861.18
Concrete Piles.			
855 piles	at $20.00	$17,100.00	
1,038 cu. yd. excavat'n.	" .40	415.00	
986 cu. yd. concrete..	" 8.00	7,888.00	
Shoring and pumping.........		......	
Total cost			$25,403.00
Difference in cost			$27,458.18

The saving in the cost of foundations by the use of concrete piles was $27,458.18, or more than half of the original cost of the foundations as designed with wood piles.

The estimate of length of wood piles was taken from the length of wood piles driven in the marine engineering building, a structure about 200 ft. from the library site. Wood piles would have been required 40 ft. in length at a cost of 20 cents a foot, and would have been on average driven 30 ft. below mean low water, which at 5 cents a foot would mean an average cost of $9.50 per pile.

For the estimate for excavations it was assumed that the entire site was at an elevation of 7 ft. above mean low water, which is an average of the existing conditions.

The longest concrete pile driven was 29.7 ft., but owing to the solid nature of the soil at the southerly end of the library building, where shorter piles were used, the average length was 16 ft., and the cost of the concrete piles was taken at $20 per pile.

The concrete pile selected was that of the Raymond Concrete Pile Co., of Chicago. It is conical in shape, running from 6 in. in diameter at the bottom to 20 in. at the top. Owing to this conical shape the ground is compacted and a much shorter pile can be used with this style than with a cylindrical pile. The difference in bearing power between a conical and a cylindrical pile was shown by an experiment tried on this work at the Naval Academy. A Raymond pile core tapered from 6 in. at the point to 20 in. at the head, was driven 19 ft. until the penetration under two blows from a 2,100-lb. hammer falling 20 ft. was ⅞ in. A wood pile 9½ in. at the point and 11 in. at the head and having the same length, 19 ft., as the conical pile, had a penetration of 5 5/16 in. under two blows of the same hammer, falling 20 ft. This pile was driven after the concrete pile and about 2 ft. from it, thus showing the comparative bearing power between a conical and a cylindrical pile of the same length.

These piles of the Raymond style are driven by the use of a hollow steel core 6 in. in diameter at the point and 20 in. at the head. The cores used on this work were 20 and 30 ft. in length. The exterior pieces of the core are spread and held in place during the driving by a wedge device shown in one of the illustrations. The core is held in the leads of the pile driver by steel plates, fastened to its top, which form guides to slide in the leads. The top of the steel core is protected by a hard wood cap-block which sets in a cavity made for it. This block receives the blow of the hammer and has to be renewed from time to time.

The sheet-steel shells are formed on the work in an extra heavy cornice break machine, and are made in 8-ft. sections with locked seams. The sections are telescoped, the point of the core is raised about 8 ft. and inserted in the smallest section; then the other sections are drawn up around the core by a line from the hoisting engine on the driver. Two drivers were used on the work at the Naval Academy, one with a 2,240-lb. drop hammer, and the other a steam hammer of the Vulcan make, weighing 3,000 lb. The steam hammer was found more satisfactory, working much more rapidly. This was partly due to the fact that the steam hammer was mounted on a turn-table, and was able to turn in a circle by its own power. It was also provided with an extension top by which the core could be raised, or lowered, if necessary, in a trench below the driver. This extension is shown raised in one of the illustrations.

The first piles were driven until twenty blows with the steam hammer caused a penetration of 1 in. This was found to be very severe on the steel core, and later tests on loaded piles proved that it was unnecessary to have such a small penetration, and it was reduced to eight blows for a penetration of 1 in.

When the driver with the drop hammer was brought on the work some comparison had to be made between the blows of the two hammers, so that the cores would be driven to the same penetration, to give an equal bearing for all parts of the building. A core was driven with the steam hammer until the penetration with eight blows was 1 in. This core was detached from the leads of the steam hammer and left standing in the ground; then the driver with the drop hammer was moved up and four blows from the 2,240-lb. hammer falling 20 ft. was found to drive it 1 in., or a penetration of ¼ in. for a blow. As previously stated, eight blows of the steam hammer in rapid succession drove the core 1 in., and the conclusion was reached that one blow of the drop hammer was equivalent to two blows of the steam hammer.

Placing a Shell.

Core Used inside Shell.

Steam Pile Driver and Concrete Piles, Annapolis.

The tests were made by loading the piles, and it was estimated that all piles with the same penetration as the test piles would have the same bearing power. A 17½-ft. pile driven with a 20-ft. core, 6 in. in diameter at the point and 20 in. at the head, having a penetration of 1 in. under twenty blows of the steam hammer, was loaded with 41 tons. Levels were taken during the loading and at intervals for one month. At the end of the month the total settlement was 0.007 ft., or 3/32 in.

Another 28½-ft. pile was driven with a 30-ft. core, 6 in. at the point and 20 in. at the head, had a penetration of 5/16 in. under ten blows with the steam hammer. This pile was loaded with 42 tons. Levels were taken during the loading, showing a settlement of 0.002 ft., and at intervals for one month, showing no additional settlement. This pile was driven outside of the old sea wall in that portion of the land reclaimed from the Severn River, which had been filled with sand and mud three years previously.

A test pile was driven at the northerly end of the building on that part of the ground reclaimed from the Severn River. This pile was driven with a 30-ft. core a distance of 22½ ft., having a penetration of 1 in. for eight blows with the steam hammer. The diameter of the pile was 6 in. at the point and 16 in. at the head. It was loaded with 41 tons and had a settlement of 0.007 ft., or 3/32 in. Ten days later it showed a total settlement of 0.009 ft. The load was then increased to 45 tons, with no additional settlement, and finally it was increased to 66½ tons, showing a total settlement of 0.035 ft., or less than 7/16 in. There was no additional settlement when the load was removed six days later.

Table 2 gives the elevations taken on this pile during the month the test was being made.

It will be noticed that the pile rose about ⅛ in. when the load was removed. This difference was at first supposed to be an error in the level work, but was checked several times, giving the same result. This led to a study of past records on piles of other systems, and it was found that this rising after removing the test load had occurred on piles in various parts of the country. It was assumed to be due to the elastic nature of the soil.

Table 2.—Test on Concrete Pile, Academic Building, U. S. Naval Academy.

Concrete mixture, 1:3:7. Length of core, 30 ft. Length of pile, 22½ ft. Diameter of pile head, 16-in. Diameter of point, 6-in. Penetration, 1-in. for eight blows No. 2 Vulcan steam hammer. Concrete 13 days old at beginning of test. Ground filled with sand and mud in 1901.

		Settlement	
Date—1904.	Load, tons.	Since last reading.	Total.
Sept. 1, noon....	21	—0.005	0.005 ft. = $^1/_{16}$-in.
Sept. 1, 5:00 P.M.	31	0.000	0.005 " = $^1/_{16}$-in.
Sept. 3	31	—0.002	0.007 " = $^3/_{32}$-in.
Sept. 14	31	—0.000	0.007 " = $^3/_{32}$-in.
Sept. 16	41	—0.000	0.007 " = $^3/_{32}$-in.
Sept. 26	41	—0.002	0.009 " = $^7/_{64}$-in.
Sept. 27	45	—0.000	0.009 " = $^7/_{64}$-in.
Sept. 28, 11:30 A.M.	50	—0.004	0.013 " = $^5/_{32}$-in.
Sept. 28, 3:30 P.M.	54	—0.004	0.017 " = $^7/_{32}$-in.
Sept. 29	61	—0.004	0.021 " = ¼-in.
Oct. 1	66½	—0.010	0.031 " = ⅜-in.
Oct. 4	66½	—0.004	0.035 " = $^7/_{16}$-in.
Oct. 10	66½	—0.000	0.035 " = $^7/_{16}$-in.
Oct. 26	0	+ 0.009	0.026 " = $^5/_{16}$-in.

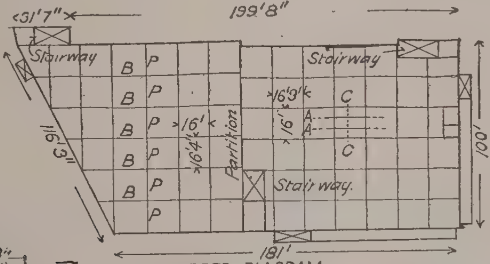
In preparing the pile for a test a spike was grouted in the concrete top, then two double 12-in. I-beams were placed on top of the pile, leaving room enough between them for a level rod to be held on the spike. On the I-beams a platform was made of 12x12-in. beams 12 ft. long, projecting on either side. This platform was loaded with chain, leaving a hole in the center for the level rod. An elevation was taken on the spike before loading, and while the load was being applied, also at intervals for a month. These elevations were taken from a nearby bench mark.

The concrete was a 1:3:7 mixture with Catskill Portland cement, sand and ⅛ to ¾-in. gravel. The average of 78 neat-cement Government tests was: Twenty-four hours, 308 lb.; 7 days, 661 lb.; 28 days, 745 lb.

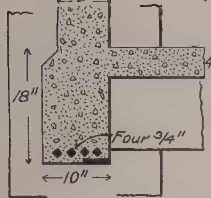
The Robert Gair Reinforced-Concrete Factory and Warehouse.

There is now under construction in Brooklyn a reinforced-concrete warehouse and factory which is an excellent example of this type of construction. It is being built for the Robert Gair Co., which makes all classes of paper goods, and will consequently contain considerable quantities of inflammable materials. The original design called for a six-story structure with brick walls and an interior construction of yellow-pine posts and girders and a double wood floor, of the standard mill type. After these plans were prepared the Turner Construction Co., of New York, suggested a structure of reinforced-concrete, with skeleton walls having large window areas set with metal frames and wired glass. The first cost of this building was but slightly greater than that of the brick and timber structure, while its fireproof character permitted the use of eight stories and a basement, each 13 ft. 4 in. high, which the New York building code does not allow with mill construction.

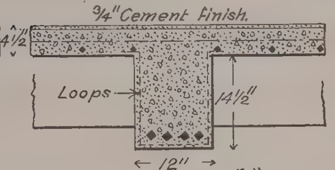
The general shape of the building is indicated in the girder plan of the first floor. It will be noticed that there are three sets of stair and freight elevator openings and a passenger elevator opening, each of which is protected by fireproof partitions and standard fire doors. There are three outside entrances, the positions of which are indicated in the diagram. Each story is divided into two portions by a concrete partition in order to reduce the fire risk. The floor load used in the designs was 200 lb. per square foot. All columns and floors are of reinforced concrete, and the roof is of the same general design as the floors. The exterior curtain walls are 8 in. thick on the three sides facing streets, and extend above the floor line to the window sill, the surface between the window sill and the floor line being flush with the windows. The pilasters in the exterior walls will be tooled, but the curtain walls will be left plain as they come from the forms. The area wall on the fourth side is self-sustaining and does not rely like the others on the support of wall girders.



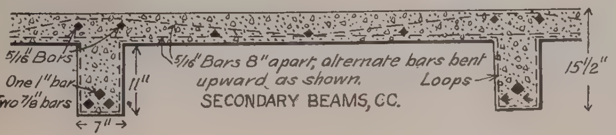
GIRDER DIAGRAM.



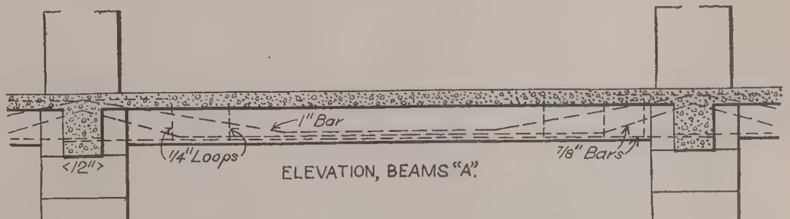
WALL BEAM.



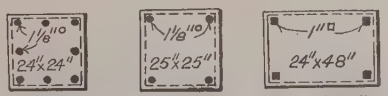
SECTION, GIRDER "P."



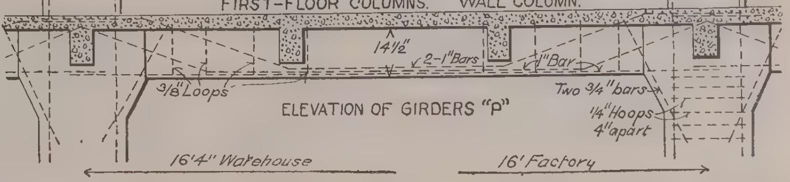
SECONDARY BEAMS, CC.



ELEVATION, BEAMS "A."

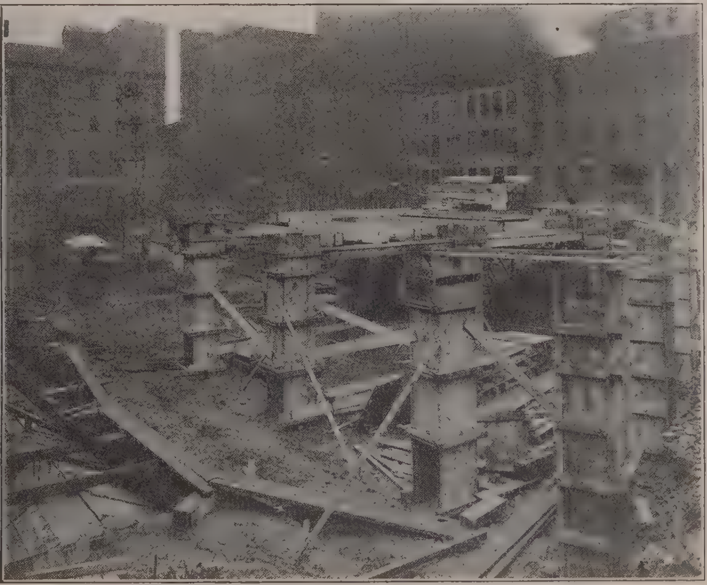


FIRST-FLOOR COLUMNS. WALL COLUMN.



ELEVATION OF GIRDERS "P"

Location of Concrete Plant.


Moulds for Basement Columns.

Foundations.—The soil at the site of this building consists of a fine sand with a small percentage of clay, making a very good support except where it might be disturbed by water. The footings are carried nearly to the water line. They were originally proportioned for a load of 4 tons per square foot on the sand, but this was changed to 2 tons total per square foot.

The wall foundations of the three sides fronting on streets are 7½ ft. wide, 6 in. thick at the edges, and 2 ft. 3 in. thick under the walls and wall columns. The reinforcement in the lower part of these footings consists of transverse 1-in. Ransome bars 6 ft. long and spaced 2 ft. on centers, and thirteen longitudinal 1-in. bars, seven of them running in straight lines near the top surface of the footing and the remaining six dropping down under each column.

The footing under the self-supporting wall on the fourth side of the building is of the same thickness as the other wall footings, but is 8 ft. 10 in. wide. The transverse 1-in. bars in the bottom are 7 ft. long and 15 in. apart. The longitudinal bars are partly bent and partly straight as in the other footings. The reinforcement varies somewhat in details under different parts of the walls, but its general features are everywhere the same, conforming with the system employed in continuous girders.

The interior columns rest as a rule on footings 12 ft. square, 6 in. thick at the edges, and 3 ft. 4 in. thick under the central platform, which is usually 3 ft. 2 in. by 2 ft. 9 in. The reinforcement consists of 1-in. bars spaced about 9 in. apart and placed in two courses at right angles to each other about 3 in. above the bottom of the footing. Vertical steel rods in the lower 18 in. of the columns are also carried 18 in. into the concrete of the footings.

Columns.—Interior columns, as a rule, are 27 in. square in the basement, 25 in. in the first floor, 23 in. in the second and third story, 21 in. in the fourth story, 20 in. in the fifth story, 18 in. in the sixth, 14 in. in the seventh, and 10 in. in the eighth. The corners are rounded to a 2-in. radius. The reinforcement of most of these interior columns consists of eight 1⅛-in. round rods 3 in. from the surface in the basement and first story, six rods in the second and third stories, and four in the stories above, their diameter decreasing to ¾ in. and their distance from the surface decreasing to 2 in. In the lower stories the bars have their ends threaded and connected by a sleeve; elsewhere the ends lay 15 to 18 in. The columns in the basement are hooped every 4 in. with ¼-in. rods, and those in the eighth floor every 10 in. with 3/16-in. rods; the hoops on the columns of the intermediate stories are between these limits in size and spacing. A few of the interior columns differ somewhat from those described in their reinforcement.

It will be noticed in the diagrams that the columns have reinforced brackets forming part of the floor girders as well as the posts.

The wall columns of the first floor are 2x4-ft. on one of the street fronts and 2x3 ft. 3 in. on the other two fronts. They are about 16 to 18 ft. apart on centers and decrease in thickness to 16 in. at the top. The reinforcement consists of four Ransome bars ranging in size from 1 in. in the first story to ½ in. in the top story. Quarter-inch bars on 12-in. centers are used for the hooping of columns of the lower stories; those of the upper stories are on 15-in. centers.

The vertical bars of the column reinforcement rest on small cup-shaped castings which distribute the load over the footings.

Girders and Beams.—The floor construction is the same in every story. The girders are marked P in the diagram; they are 16 ft. long in the factory and 16 ft. 4 in. in the warehouse, and are 16 ft. to 16 ft. 3 in. apart. These dimensions are all between centers. The girders are 14½ in. deep, exclusive of the floor, and 12 in. wide. The reinforcement is shown in the diagrams.

The secondary girders, marked B in the diagram, are similar in dimensions to the floorbeams, marked A A in the diagram. But one panel of these floorbeams is shown in the diagram, although they are, of course, provided in every panel. They are generally 5 ft. 2 in. and 5 ft. 5 in. apart, 11 in. deep and 7 in. wide. Their lengths are the same as those of the girders marked B, and the system of reinforcement is shown in the diagrams.

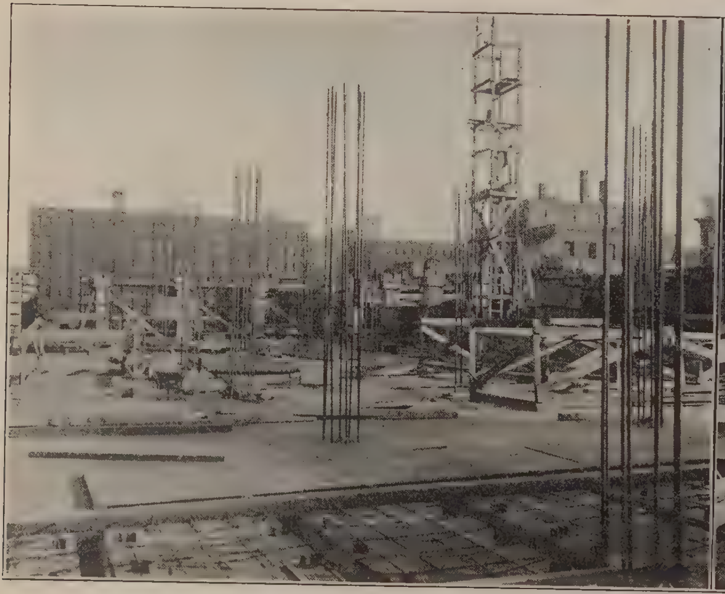
The floor is 4½ in. thick and made with the girders and beams supporting it. It is reinforced with 5/16-in. Ransome bars arranged as shown in the section C C in the diagrams. The floor is finished with ¾ in. of granolithic.

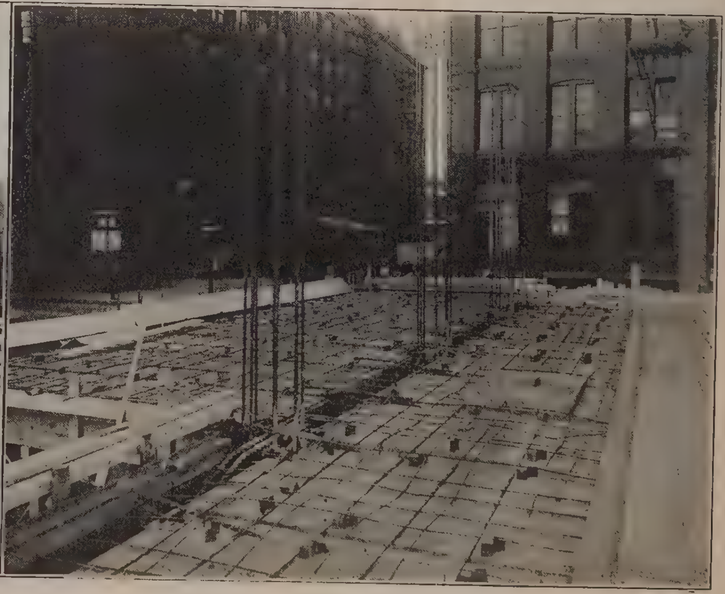
General Construction.—The interior columns are made of one part of Lehigh Portland cement, two parts of clean, sharp sand, and three parts of trap rock graded in size from ¼ to 1½ in. A 1:3:5 mixture is used for the footings, floors and walls, the rock being ¾-in. trap. The finish on the floors consists of one part of cement, one of sand and one of screenings about ⅛ in. size. The reinforcement consists of square Ransome bars twisted cold, except in the case of the round vertical rods in the columns.

The work was started on Nov. 1 of last year and continued for about six weeks, until the severe winter weather stopped operations. The concrete plant is located in the center of the site, and consists of a Ransome mixer and a self-dumping bucket hoist which will be continued up through the building.

Work on the First Story.

Moulds for Basement Columns.


Vertical Column Reinforcement.


Reinforcement of Floors.

CURRENT NEWS SUPPLEMENT

MARCH 4, 1905.

RI TORY OF NATIONAL ENGINEERING SOCIETIES.

ican Society of Civil Engineers. y, Chas. Warren Hunt, 220 West 57th v York.

ican Society of Mechanical Engi Secretary, F. R. Hutton, 12 West 31st v York.

ican Institute of Electrical Engi Secretary, Ralph W. Pope, 95 Liberty w York. Next meeting, New York, 24; papers by Ernest Gonzenbach, on tion of high-pressure to electric rail by Geo. A. Damon, on high-pressure nstruction for electric railways; and I. Varney, on the high-pressure trolley.

rican Institute of Mining Engi Secretary, R. W. Raymond, 99 John w York.

rican Institute of Architects. ry, Glenn Brown, Washington, D. C.

ciation of Engineering Societies. ary, John C. Trautwine, Jr., 257 South St., Philadelphia, Pa.

rican Society of Heating and Venti Engineers. Secretary, W. M. Mackay, ater St., New York.

adian Society of Civil Engineers. ary, Clement H. McLeod, 877 Dorchester ontreal.

iety for the Promotion of Engineer Education. Secretary, Prof. M. S. tum, University of Colorado, Boulder,

erican Society for Testing Mate . Secretary, Prof. Edgar Marburg, Uni y of Pennsylvania, Philadelphia, Pa.

erican Society of Municipal Im ments. Secretary, George W. Tillson, 12, Municipal Building, Brooklyn, N. Y.

sociation of Railway Superintendents ridges and Buildings. Secretary, S. F. son, Concord, N. H.

merican Railway Engineering and tenance of Way Association. Secre L. C. Fritch, 1562 Monadnock Block, Chi Annual meeting at Chicago, March 21, nd 23.

merican Water-Works Association. Sec y, J. M. Diven, Charleston, S. C.

merican Foundrymen's Association. etary, Richard Moldenke, P. O. Box 432, York.

ngine Builders' Association of the ted States. Secretary, J. L. Lyle, 39 landt St., New York.

THE PANAMA CANAL.

ort of the Engineering Committee, Isthmian Canal Commission.

he Committee on Engineering of the Isth Canal Commisssion sailed from New on Jan. 17, 1905, and arrived at Colon Jan. 24. Under resolution of the Com sion, Major-General Geo. W. Davis, Gov or, became a member of the Committee ing its stay on the Isthmus, and acted con ously in that capacity until its departure. Committee began its duties immediately n its arrival, and held its sessions and ferences daily at the office of the Gove or, except when engaged in examinations the actual or proposed work along the al line. The Chief Engineer of the Com sion laid before the Committee the entire a collected by the engineering field parties his force, and such maps, plans and other ords as had been prepared in his office up the departure of the Committee. He was in attendance at the meetings and con ences of the Committee and on the field ex inations, which included visits to all the ties on the entire line, as well as to all nts of interest and importance in connec with the work.

tlantic Terminal Harbor.—The interior bor at the Cristobal entrance to the Canal the adjoining works received early con eration from the Committee, because ex sive harbor accommodations are urgently ded at once to serve ships there in dis rging plant, materials and supplies for construction of the Canal. These needs are already pressing, and they will rapidly increase and become far more pressing in the near future.

The Committee examined in detail the site of this interior harbor, as well as the entire water front of Colon, on Jan. 27, while a severe norther was blowing, and its members were thus fortunate in viewing conditions bearing most impressively on the design and construction of the necessary works at the Atlantic end of the Canal. The norther began blowing soon after noon on Jan. 26, with such force that three steamships in the harbor of Colon at that time were compelled to seek safety by putting to sea and remaining away for three days. The U. S. S. "Dixie" was preparing to leave at about that time, and was obliged to hasten her departure to escape the danger of the storm. Not a vessel of any description remained in the harbor except two schooners in the slips adjacent to the Panama Railroad station, which were tied by a number of cables at a sufficient distance from their piers to prevent damage from excessive pitching and rolling. They could not get away, and were compelled to ride out the gale in grave danger to themselves and to the neighboring piers.

At the time of the Committee's visit, storm waves of great magnitude and force were rolling directly into the harbor, breaking over the entire water front of that part of Colon known as Aspinwall, and blocking the marginal streets with deluges of water and great quantities of coral rock and other débris. The same effects were produced on Cristobal Point, seriously injuring a number of houses and rendering them uninhabitable, as well as putting out of use the marginal street. The magnitude and violence of the wave action along the entire water front of Colon not only drove to sea every vessel that could get away, but it also endangered the piers or wharves, some of which have been heretofore seriously damaged in similar storms. Further than this, great inconvenience and some loss was caused, not only to the shipping interests affected, but also to the canal work in interrupting the discharge of cargo urgently needed, and in other ways injuring Isthmian transportation.

These storms occur on the average but once or twice a year, and during some years they do not occur at all. For probably not less than 360 days in the year the harbor of Colon is free from any objection of this kind. If the construction of the Canal were a purely commercial enterprise, the protection of an outer terminal harbor open to storms at rare intervals, as in this instance, would not be justified. This project, however, is a great public work by the United States Government, in which no feature contributing effectively to either safety or efficiency should be omitted.

It is, therefore, the unanimous and unqualified judgment of the Committee that a harbor directly open to such heavy storm seas as to drive out shipping and endanger water front structures, even if the storms occur on the average but once or twice a year, is clearly unsuitable even for the outer harbor at the entrance of the Panama Canal, where many ships must from time to time necessarily lie at anchor. For these reasons, the Committee unanimously recommend that plans and specifications be at once prepared for a breakwater extending across the mouth of Limon Bay approximately on the line drawn from the light on Toro Point to the Colon light. This breakwater will probably be designed in two parts, each about 4,000 ft. long, with an opening between them 700 to 800 ft. wide for the entrance of ships.

It is the judgment of the Committee that the construction of that portion of the breakwater nearest to Colon should be commenced at the earliest practicable date: This would insure a substantial measure of protection in the near future for the piers and wharves of the Colon water front, where ships may at all times transfer cargoes in safety. The remaining portion of the breakwater could then be constructed, if experience should show it to be necessary, or it can be omitted if there should prove to be sufficient harbor protection without it.

The rock required for the breakwater can be obtained of proper quality and in any desired quantity from the deep portions of the summit cut of the Canal between Obispo and Culebra, from the quarry at Bohio and from Kenney's Bluff on the west shore of the Bay of Limon. The hard rock of the summit cut is well adapted to the requirements of the superstructure. The cost of quarrying is not, therefore, an element of cost of the breakwater.

The interior harbor at the entrance of the Canal immediately south of Cristobal Point, as proposed by the new Panama Canal Co., is urgently needed even at this time. Temporary timber pile wharves at Cristobal and adjacent to the entrance to the dry dock, half a mile further south, have already been completed and used; but they are of small capacity and there is insufficient depth of water in front of them. This harbor and the channel from the outer bay should be dredged at once and substantial timber quays or wharves should also be constructed immediately.

At its meeting on Feb. 1, this Committee unanimously passed the following resolution:

"1. Resolved, That the Committee approve and recommend to the Commission 30 ft. as an immediate depth for the inner harbor at Cristobal and approach thereto, beginning at the 30-ft. contour in the outer harbor, and extending thence to Station 51, where it appears that indurated clay will be met at that depth. The width of approach channel should be about 500 ft., and that of the inner harbor about 1,000 ft., except as narrowed at the north end of Mangrove Beach Island, to reduce coral rock excavation, and widened at turn to make a basin."

This harbor, so constructed as to bring conveniently along its quays the tracks of the Panama R. R., will be of the greatest value during the entire progress of the Canal work.

In order to cover all possible contract work which it may be desirable to undertake along the approach channel and interior harbor heretofore contemplated as parts of a finished canal and entrance harbor, this Committee, at the same meeting, unanimously passed the following resolutions as expressing further recommendations to the Commission:

"2. Resolved, That bids be invited for dredging from the outer harbor to Station 51 on the widths as in the preceding resolution, and from Station 51 to Station 100 for a width of about 1,000 ft., all at depths of 30, 35 and 40 ft.

"3. Resolved, That the material be classified as: 1, coral and other rock; 2, indurated clay; 3, sand and mud; and that bids be asked for delivering material excavated by pumping at any point within 2,000 ft., as selected by the Engineer, and with extra prices for each 1,000 ft. in addition. Hard material shall be carried to and dumped at sea within a maximum distance of 3 miles from Cristobal Point, as directed by the Engineer.

"4. Resolved, That the Chief Engineer be directed to prepare the plans and specifications for the work, as indicated by Resolutions Nos. 1, 2 and 3."

Although the interior harbor and approach channel as planned and recommended should be built immediately, it is the unanimous judgment of this committee that with the construction of the breakwater, a direct entrance to the canal at or near Boca Mindi, with a straight approach channel from the outer harbor, has such substantial advantages that it should be adopted, independently of and in addition to the canal connecting with the inner harbor as heretofore planned. Ships may then proceed directly through the outer harbor into the canal, or into the inner harbor for coal or other purposes, and thence into the canal. The proposed direct entrance and approach channel are shown on the plans submitted by the Chief Engineer.

The estimated quantities of material required to be excavated, or to be used for the construction of the breakwater, are as follows: Common rock fill, 3,000,000 cu. yd.; hard rock, 400,000 cu. yd.

Gatuncillo River.—At the present time the waters of the Gatuncillo River flow through a diversion channel south of Gatun into the Chagres River at that point. The combined flow of the Chagres and Gatuncillo is taken almost entirely into the channel of the former to the point where it cuts the canal excavation, a short distance north of Gatun, where the joint discharge divides, the larger part following the Chagres to the sea and the remainder flowing through the canal excavation to Boca Mindi, where it escapes through the enlarged mouth of the Mindi River into Limon Bay. The natural result has been the formation of a large bar, filling almost the entire canal channel immediately north of Boca Mindi. This action has been intensified when floods have filled the Gatuncillo and Chagres Rivers.

The old Panma Canal Co. nearly completed what is known as the Gatuncillo diversion channel, located east of and mainly near to the canal line from the Gatuncillo River to Puerto Escondido in Manzanillo Bay. The continuation of this diversion southerly was partially excavated at numerous points from Gatun to Gamboa, easterly of the canal line, and it will probably have to be completed throughout that entire distance. Immediate attention, however, is directed to that portion already described and called the Gatuncillo diversion, which receives the waters of not only the Gatuncillo River, but also of the Mindi and other smaller streams flowing down from the high ground in that vicinity, and thus prevents them from entering the canal.

Whatever may be the final plans of the canal, or of its subsidiary work, this diversion must be completed and employed to discharge the waters it received into Manzanillo Bay. The bottom width of the present excavation is about 115 ft., and it originally had a depth of water of about 15 ft. Silt and mud have now settled in it to a depth of 1 to 4 ft., leaving from 10 to 14 ft. of water. Two short stretches still remain to be excavated, one, back of Monkey Hill, about 1,600 ft. in length of hard, indurated clay, and the other about 2,000 ft. in length, mostly of mud, silt and sand, near the Mindi River, where the railroad crosses its line; besides any enlargement of section that may be necessary.

Two small dams must also be constructed about 2,500 ft. apart, across the Chagres River near Mindi, to retain within the diversion channel the waters which must not enter the canal. A diversion of the Chagres on the westerly side of the canal, in the same vicinity, must be retained to take the flow of the Chagres directly to the ocean. Another dam must be built across the Boca Mindi, on the line of railroad, to prevent the discharge of the Gatuncillo diversion through that opening which its waters now follow. These three dams and the Chagres diversion are necessary to complete the separation of the waters intended to flow through the Gatuncillo diversion and the Chagres River.

All the works thus far discussed are quite independent of the type or dimensions of the canal south of Gatun and their construction is imperative; therefore, this Committee unanimously recommends their immediate completion.

Cost of Excavation.—Before other subsidiary questions can be decided or even considered, a determination must be reached as to the elevation of the summit level. The plan of the French company under which they were working placed this level at 97.5 ft. above mean tide, to be supplied with water from a storage lake at Alhajuela, which was also to regulate the Chagres. The former Isthmian Canal Commission considered a summit level at 85 ft., to be maintained by a large dam at Bohio, making a lake with an area of 38.5 square miles, and thus regulating Chagres floods.

When the present Commission was created it was realized that before a final determination could be made with propriety, additional data should be obtained other than that possessed by the French company or secured by the former Commission, and especially that positive information should be had as to the probable cost of excavation, for on such cost, both as to time and money, will the type of the canal in large part depend. Survey parties were at once established and contracts let for the installation at Culebra of a modern excavating plant.

The work of excavation in the summit or Culebra cut has been actively prosecuted under the direction of the Chief Engineer, so that the total quantity excavated during January was about 71,000 cu. yd. The first three steam shovels of the seventeen recently contracted for in the United States are now set up and at work, although the third one had not made a beginning of its work on February 1. A shovel has exceeded a daily output of rock excavation of 1,000 cu. yd. The operations of the shovels have been entirely satisfactory, and they have already proved themselves to be machines of high efficiency. Indeed, the results so far attained indicate that there is no other type of machine better adapted to the class of work to be done in the summit cut or which can reach a greater efficiency. The French excavators have also been put in a much more efficient condition, so that in clay excavation a single machine has also reached a daily output of nearly 1,400 cu. yd., but they are not well adapted to rock.

As a result of the experience thus far gained in the actual rock and clay excavation at Culebra, the average monthly cost per cubic yard has fallen below 50 cts. The Chief Engineer, therefore, is confident that the average cost of all the excavation in the summit cut will not exceed 50 cts. per cubic yard, and this Committee concurs in that opinion. The former Isthmian Canal Commission assumed in its estimates that the average cost of excavation in the great summit cut would be 80 cts. per cubic yard. The demonstrated cost of this Commission's actual work at Culebra, if applied to the quantities employed by the former Commission, would reduce the total estimated cost of the canal about $15,000,000.

Cost of Canal.—This large saving in cost makes a fundamental reconsideration of canal plans by this Commission essential. It is obvious that this actual reduced cost of excavation justifies a reduction in the elevation of the summit level of the canal by a correspondingly greater volume of excavation. After a careful consideration of all the elements of this portion of the canal problem, this Committee, as an expression of its judgment, passed unanimously the following resolution on Feb. 1:

"7. Resolved, That the elevation of the summit level of the canal should not exceed 60 ft."

The Chief Engineer has prepared full statements of estimated costs of construction of the canal for three different summit elevations: 1, with summit elevation at 60 ft. above mean tide; 2, with summit elevation at 30 ft. above mean tide; 3, a sea level canal. The total estimated costs of these three types of canal, including the breakwater, direct approach channel and interior harbor at Colon, will be: Summit level at 60 ft. elevation, $178,013,406; summit level at 30 ft. elevaton, $194,213,406; sea level, $230,475,725. These totals include a margin of 20 per cent. for contingencies, administration, sanitation and engineering.

Chagres River Control.—The effective control of the Chagres River, especially during its floods, which are frequently sudden and of great volume, has also been considered in all its relations to the plans of the canal which may ultimately be adopted. Inasmuch as the elevation of the water in the Chagres River at Gamboa is about 55 ft. above mean tide, or but 5 ft. below a summit level placed at 60 ft. above mean tide, it is the judgment of this Committee that the control of the Chagres River, with a summit level at an elevation of 60 ft. or less, should be effected at or in the immediate vicinity of Gamboa, which the examinations made by the field party operating at that location and in the valley of the Chagres above Gamboa, show to be entirely feasible.

For these reasons, the Committee unanimously passed the following resolution:

"8. Resolved, That in the event of the Commission approving Resolution No. 7, that the Chagres River be retained by a dam located at Gamboa, and built to a crest height of about 200 ft."

The complete data secured by the surveys and examinations of that field party show that the high hills on both sides of the river at Gamboa, in connection with the maximum depth of bed rock in the river, about 56 ft. below low water, render the construction of the dam across the Chagres at this location, with the attendant works of pipes and gates and waste weir, reasonably free from serious difficulties and bring construction within reasonable cost. Surveys show that the area enclosed within the flow line of the lake formed by this dam for the elevation of water surface at 200 ft. above mean tide, would be 43.3 square miles; at the elevation of 170 ft., 30.8 square miles; and at the elevation of 132 ft., 14.9 square miles.

Accurate flood records for the Chagres River have been kept during the past 13 or 14 years only. The greatest flood which has occurred since the beginning of the construction of the Panama Railroad in 1851 was that of 1879. No authoritative record of the highest water at any point nor of the maximum discharge of that storm exists. The storm which caused this flood lasted about six days, and approximate evidence of its highest stage at Bohio is preserved in the memories of some persons now living. All the reliable information that can be ascertained has been used to determine approximately the greatest rate of discharge of the Chagres at Bohio, which is supposed to have been about 136,000 cu. ft. per second. It has further been concluded that the average discharge for 48 hours was about 112,000 cu. ft. per second. While these results are approximate only, it appears that they may be safely employed for the determination of some general features of control. The results for Gamboa are somewhat less, both in rate and in total volume, than at Bohio. If an average discharge of 100,000 cu. ft. per second for 72 hours be assumed at Gamboa, the resulting computations will certainly lead to safe conclusions regarding the capacity for control of the proposed Gamboa lake. If that amount of water flowed into the lake formed by the proposed Gamboa dam, with an initial water surface of the lake at an elevation of 160 ft., such a three days' inflow, with no outflow, would raise that surface not more than 30 ft., or to the elevation of about 190 ft. If, on the other hand, a uniform outflow of 20,000 cu. ft. per second were maintained during the same length of time, the resulting rise of lake surface would be but a little over 20 ft., thus raising the elevation of that surface to slightly above 180 ft. The Gamboa lake, therefore, may be used in this manner as an effective control of the Chagres River, even during the highest flood which there is any reason to anticipate.

The greatest volume of continuous inflow into the lake which could take place under the authentic records of the past 14 years, is about 365,000 acre-feet per month for six consecutive months in 1892, and of 700,000 acre-feet for one month in 1894. A continuous outflow of not more than 10,000 cu. ft. per second during these two periods of inflow would enable the lake to take care of both these periods of great discharge, without raising the surface of water more than a few feet and for a short period only.

While further detailed studies beyond those which were available to the Committee on the Isthmus, are required to determine the exact elements of this problem of the control of the Chagres during varying periods of high rates of inflow, the examination made by this Committee shows conclusively that the lake proposed has sufficient capacity to afford abundant regulation of the Chagres floods.

Dam and Outlet, Gamboa Lake.—The necessary rates of the outflow from the lake during flood periods may be obtained by means of large pipes and gates built into the dam itself, together with a waste weir at the same point, or by means of a tunnel about 3.4 miles long through the dividing ridge between the Chagres and Gatuncillo watersheds, or by both. The elevation of the invert of this tunnel at the Chagres end may be placed at 132 ft. above mean tide. If such a tunnel were built at the elevation named, with a diameter of 30 ft., it could be depended upon to discharge 15,000 cu. ft. per second, with the elevation of water surface between 180 and 185 ft., the mean velocity of water through the tunnel being about 20 ft. per second. At least the same rate of discharge, and a greater one, if required, may be obained through properly controlled pipes at the dam, discharging either into the canal or into a diversion channel on the easterly side of the Chagres River, constructed the entire distance to the Gatuncillo diversion, or into both.

Surveys for the location and estimate of cost of the tunnel for discharging into the upper waters of the Gatuncillo, have already been completed, as well as for a similar tunnel to discharge into the Pacific. Complete surveys are about to be undertaken to ascertain the exact amount of work which has been done on the Chagres diversions between Gamboa and Gatun, so as to make an accurate estimate of the cost of their completion. As soon as these latter surveys are completed, the exact estimates of cost, both for the tunnel and for the diversion discharge, can be made, and all the details of these features of the regulation works can be determined.

Work on the foundation for the dam at Gamboa can be begun at once. This portion of the construction of the dam will probably require from a year to a year and a half of time, and it is the unanimous judgment of the Committee, that it should be undertaken immediately, and that the construction of the entire dam should be completed as soon as practicable.

The building of the lam at Gamboa will not only furnish complete and effective means of control for the Chagres floods, but it has the further advantage of being entirely accessible by the Panama R. R. for the transportation of men and materials. The plan of the dam will probably require a masonry core, with a great mass of earth and rock fill on either side of it, from the waste excavation of the summit cut. The plan, therefore, has marked merits of both efficiency of control and economy of construction.

The conditions attending the construction of this dam are in no way unprecedented. The depth of bedrock below water surface is only about one-third that at Bohio, and no greater than has already been reached by the use of heavy timber sheet piling for founding masonry structures in the United States. The proposed height of this dam from its foundation to its top is far less than found in a number of masonry dams already built, and the making of the earth embankments on the two sides of the masonry core is simply wasting the material from the summit cut. The construction of the Gamboa dam, therefore, involves no formidable obstacles not heretofore successfully encountered in engineering practice.

Practicability of Sea Level Canal.—The practicability of certainly and satisfactorily controlling the floods of the Chagres by so simple and economical a method as the Gamboa Lake and its outflow channels, and the reduced cost of excavation as actually demonstrated by the work of the Commission in the Culebra cut, makes the construction of a sea-level canal at a reasonable cost, far more available than has heretofore appeared possible. These recent developments in the conditions attending the construction of the canal are so important as to be almost controlling in character. The remaining element is that of the time required to make the great summit excavation. It is to be carefully observed that the results thus far obtained in the Culebra cut have been reached under disadvantageous conditions of both organization of plant and force. The railroad tracks serving the excavators are yet fragmentary and tentatively placed to serve the purposes of investigation. In both respects the disposition of plant is far more unfavorable, both to economy and celerity of operations, than will be the case when a complete track system has been arranged and laid down to serve a large number of steam shovels operated by an experienced force. In the face of these disadvantageous conditions, the cost of excavation has been reduced far lower than was anticipated and it has been demonstrated that each steam shovel may be counted upon to yield an average record of at least 1,000 cu. yd. per working day. The Chief Engineer estimates that with 100 steam shovels installed, with a complete system of tracks serving them, a yearly record of 30,000,000 cu. yd. of excavation may be reachel without requiring a greater output per shovel, or greater speed in working, than has already been attained. This rate of working could probably be reached within two years from the present time.

With the rate of progress which now appears reasonable to anticipate, this Committee believes that a sea-level canal, with a tidal lock 1,000 ft. long and 100 ft. usable width, at Miraflores, can be completed within 10 to 12 years from this time, the bottom width of the canal being 150 ft. and the minimum depth of water 35 ft.

These considerations have induced this Committee to express to the Commission its unanimous judgment that with the contemplated system of working, and with the rate of development which appears to be justified by the work now being performed at Culebra, a sea-level canal, free from the restriction of locks,
should be adopted. This Committee b
that such a canal, with terminal harbo
be constructed for a sum not exceeding
500,000.

The advantages of a sea level canal
the Isthmus are most obvious. It wo
a waterway with no restriction to navi
and could easily be enlarged by wider
deepening at any time in the future,
commodate an increased traffic, witho
inconvenience to the shipping using it,
as a lock canal is in reality a perman
striction to the volume of traffic and
ships that use it. Although it is poss
design and construct locks adapted
future transformation to a sea level
that transformation cannot be made w
serious inconvenience to navigation,
a cost so great as to be excessive. Th
tional cost of a sea level canal over t
a canal with locks, with a summit l
60 ft. above mean tide, is $52,462,0
$79,742,000 more than the estimated
the lock canal with a summit level
above mean tide proposed by the
Isthmian Canal Commission, after al
$6,500,000 for the Colon breakwater a
rect entrance not previously estimated.
Committee considers this additional ex
ture fully justified by the advantages s

The Canal Section.—This Committe
considered most carefully suitable dime
for the cross-sections of the canal to be
It has had in view the dimensions
ship canals now built and in use, such
Suez, the Manchester, the North Sea
other similar waterways. The fact ha
been carefully borne in mind that the
New York is deepening its entrance cha
40 ft. On the other hand, it is reco
that the depth of the Suez Canal is less
30 ft., that the depth of the Manc
Canal is 26 ft. (under Act of Parliame
depth may be 28 ft.), the North Sea
32.8 ft., and the Kiel Canal 29.5 ft.
also recognized that at the present ti
loaded ship either enters or leaves the
of New York drawing more than abo
ft. It is believed, therefore, that for
years the commerce seeking the P
Canal will be amply accommodated
depth of water not exceeding 35 ft.

In view of these considerations, this
mittee expresses its recommendation t
Commission by the following two resol
unanimously passed in its meeting of F

"9. Resolved, that 150 ft. be recom
ed as the minimum bottom width.

"10. Resolved, that 35 ft. be recom
ed as a minimum depth, but that esti
be prepared for a depth of 40 ft. as we

If a canal with locks should ultimat
determined upon, this Committee is o
opinion, in view of the restrictions
such structures impress upon a growing
merce, and in view, also, of the difficul
costly process of transformation to a sea
canal under any practicable conditions,
the locks should be made of 1,000 ft.
length and 100 ft. usable width, but
with intermediate gates so as to acco
date small ships with less consumpti
water and less time required to pas
locks.

The Bohio Dam.—The borings along
sites proposed for the dam across the Ch
near Bohio have shown that bed-rock is
er than has been supposed at all the
contemplated. The greatest depth to
both at the French site and on that
tively proposed by the former Isthmian
Commission, is about 158 ft. below sea
and but little less at a third site a shor
tance upstream from the former, as
by the borings thus far made. These r
indicate greatly increased difficulties i
construction of any dam in the vicini
Bohio. Further borings are now being
at a site near Buena Vista, little more
half a mile above the French site, wh
depth of bed-rock seems to be at sensibl
depth. The investigations now in pro
will soon be completed. Their completi
necessary to determine the most advan
ous dam site in the vicinity of Boh
Buena Vista, if such a dam should be req
These borings, like others previously ma
this location, have disclosed coarse, gra
material freely water-bearing down to
rock at many points, as well as occas
fragments of timber. This clearly indi
the necessity of cutting off sub-surface
along the deepest bed-rock, in case a
should be built at this location. These
ditions are formidable because they are
at such great depths.

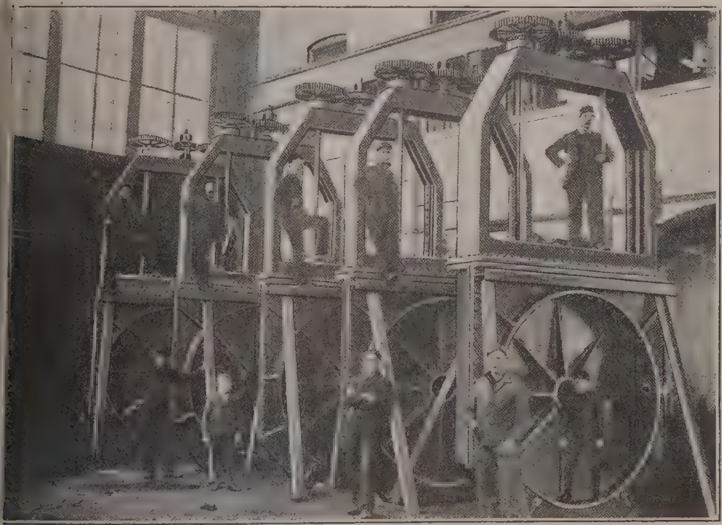
itun Dam.—The surveys and exam- which have been made in regard to e dam site across the Chagres River . show that such a structure is not The width of the floor of the val- .at point is about 5,000 ft., and two nade at what appears to be the most section penetrated to a depth of 1 139.2 ft. below sea level respective- out finding bed-rock. Other exam- and borings have also been made at :tions of the Chagres valley where a seemed possible, between Gatun and ut with equally unfavorable results. ar, therefore, that it is not feasible ruct a dam across the Chagres River point lower down in its course than).

examinations made along the alter- ine between Bohio and Gatun, known Tiger Hill cut-off, show that it will be o construct, and that for a consider stance between Tiger Hill and Bohio l be necessary to retain the water in al by embankments not less than 20 , in some cases on soft ground. This tee is, therefore, unanimously of the that it is advisable, both on the score omy and of safety of construction, to the present canal line between Gatun hio.

ae meeting of this Committee, held on 4, the following resolution was unani- adopted:

Resolved, that this Commission ap- and recommend for adoption by the ssion a plan for a sea-level canal, with om width of 150 ft., and a minimum of water of 35 ft., and with twin tidal at Miraflores, whose usable dimensions be 1,000 ft. long and 100 ft. wide, at al estimated cost of $230,500,000. Such ate includes an allowance for adminis- on, engineering, sanitation and con- encies, amounting to $38,450,000, but out allowance for interest during con- ction, expense of Zone Government and teral costs, and water supply, sewers, or g of Panama or Colon, which last items to be repaid by the inhabitants of those s.

he report is signed by Commissioners , Parsons and Davis as the Committee ngineering.)

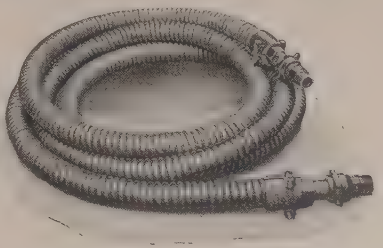


VALVES FOR DETROIT INTAKE TUNNEL.

STEEL-ARMORED HOSE.

e troubles contractors experience through breakage of steam and air hose are too known to need explanation. They are ent enough on some classes of work to e a considerable loss through the inter- ion of operations. In order to provide eans for avoiding them a flexible steel- red hose has been put on the market by Sprague Electric Co., of New York. It ists of a high-grade rubber hose closely red with an exterior metal armor con- g of interlocking strips of galvanized wound spirally in such a manner as to great flexibility. The bursting strength e rubber hose is much increased by this ection, and it is thus made capable of ing water under very high pressures.

e steel protection of the hose is the re which will make it particularly useful to most contractors, particularly as the protection is afforded by means which also prevent the kinking of the hose while it is being handled. This reduces the chances of rupture to a minimum. Even should rupture occur through the failure of some place where the rubber is over-vulcanized, the steel armor binds the ruptured place so tightly that very little pressure is lost and the work is not stopped. This feature enables the hose to continue in service until a new piece can be obtained. The hose has been in use but a short time, but the following extract from a letter from one of the people who have employed it will give some idea of the character of service of which it is capable: "We put the hose into operation early in October of last year, and it has been in constant use under 110 lb. steam pressure, and at the present writing (Jan. 31) looks good for several months longer." The company will shortly issue a bulletin, No. 5058, describing the hose, which will be sent on application to the main office, 527 West 34th St., New York.

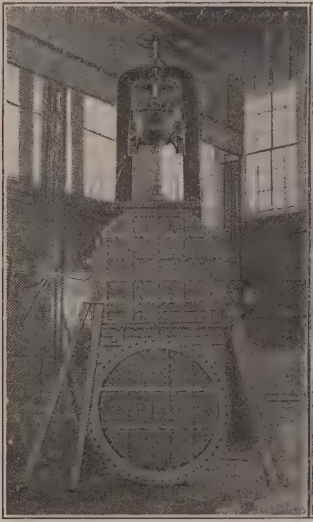


STEEL ARMORED HOSE.

SOME LARGE GATE VALVES.

The accompanying illustrations give a general idea of some large gate valves recently made by Mr. C. W. Thomas, who bought out the Michigan Brass & Iron Works, of Detroit, some time ago. The 7-ft. valve, of which a front view is shown, was made for the intake tunnel of the Detroit water-works. Five of these valves are shown in another view, which gives some idea of the magnitude of the valve equipment which Mr. Thomas will furnish for this tunnel, comprising 5-ft. emergency valves and 6-ft., 7-ft., 8-ft. and 10-ft. gate valves, the latter weighing about 60,000 lb. apiece and the others from 18,000 lb. up.

Another cut shows a 66-in. flanged gate valve with attached motor, which was furnished in January to the Rochester Railway & Light Co., of Rochester, N. Y. This large valve has but a single stem, and could be opened and closed by one man with one hand when no pressure was on it.



VALVE FOR ROCHESTER.

VALVE FOR DETROIT.

TRADE PUBLICATIONS.

The Unit accumulator is described in considerable detail in a pamphlet issued by the National Battery Co., 368 Massachusetts Ave., Buffalo. These cells are made in several sizes and the pamphlet gives full tables of their dimensions and capacities.

The Stanley Electric Manufacturing Co., Pittsfield, Mass., in its bulletin No. 140, gives a description of the two-pole double-throw oil switch, with automatic overload attachment, which it has placed on the market.

F. L. Schmidt & Co., 41 Cortlandt St., New York, are distributing a large wall calendar having a well-executed humorous colored design which shows the perils that encompass the life of even the most humble workers in concrete.

In 1885, after ten years' experimental work, the gyratory rock crusher was made a commercially successful machine. Since then it has been steadily improved in details and material, so as to increase its capacity and decrease both the power required to run it and the cost of repairs. The Allis-Chalmers Co., Milwaukee, has issued a well illustrated book describing its D type of breaker, which has a bottom shell designed to avoid the necessity of an oak base. The construction of the machines and their operation are described at length, and illustrated suggestions are given for the construction of portable plants of different capacities, up to a large plant mounted on a standard gauge flat car. The new F breaker, for use in laboratories, is also explained. Full tables of dimensions are given of machines of different capacities from 2 to 200 tons per hour.

The Rand Drill Co., New York, has recently issued two new compressor catalogues. One describes fully the Imperial type 10 steam, belt, gear and silent chain-driven air compressors; it gives tables of speeds, capacities, air pressures, horse-powers and other data and is illustrated by cuts of various sizes of these machines. The second new catalogue describes the Imperial type 11 vertical machine, which is built for driving by belt, gear and silent chain. The company has also issued a fourth edition of its catalogue C of air and gas compressors. It lists and describes many of the various types of steam (Corliss, Meyer and plain), belt, gear and chain driven compressors. It has articles on water impulse and sectional machines, and has many cuts showing the construction of the Rand standard and special compressor. The book also contains articles of a semi-technical character which explain the phenomena attending the compression and expansion of air; also a number of tables of much value to those interested in the study of air compression.

BUSINESS NOTES.

The Jackson, Mich., Engine & Motor Co. has changed its name to The Field-Brundage Co., and has increased its capital stock from $30,000 to $60,000. The company builds the Miller and the Field stationary and portable gasoline engines from 3 to 50 h.p., and will erect a 300x60-ft. building. The officers of the company are: Pres., L. H. Field; Vice-Pres. and Gen. Mgr., W. D. Brundage; Secy. and Treas., Rayner Field; Sales Mgr., C. H. Rittenhouse.

The York, Pa., Mfg. Co. reports the following among recent contracts: City Ice Co., Ltd., Shreveport, La., 175-ton refrigerating machine; Electric Cold-Storage Co., Chateaugay, N. Y., 7½-ton refrigerating and brine cooler plant; Theo. Smith & Sons Co., Jersey City, N. J., two 65-ton refrigerating machines and brine cooler plant for the Jersey City abattoir; Southern Public Service Corporation, Washington, D. C., 15-ton ice-making plant to be installed at Oxford, N. C.; Burkle & Rehm, Bridgeport, O., 20-ton refrigerating plant; Interstate Ice & Cold-Storage Co., Kansas City, Kan., 75-ton ice-making plant; Maumee, O., Electric Co., 40-ton refrigerating machine and 20-ton ice-making plant; Fort Smith, Ark., Ice & Cold-Storage Co., 50-ton freezing and distilling system; People's Land Co., Pittsburg, 20-ton refrigerating plant; H. B. Reticker, San Luis Obispo, Cal., 6-ton ice-making plant; Clarksville, Tex., Ice Co., 10-ton ice-making plant; Citizens' Ice Co., San Antonio, Tex., 35-ton freezing system; Westerberg & Williams, New York, 5-ton refrigerating plant for Woman's Hospital; Kingan & Co., Baltimore, direct-expansion piping; Washington, D. C., Market Co., 250-ton double-pipe brine cooler system; Pearman, Watlington & Co., Hamilton, Bermuda, 40-ton cross-compound compression side.

The Boston office of Warren Webster & Co. is now located in the Penn Mutual Bldg., 24 Milk St. Bower & Horgan are the engineers in charge of the office.

The second Scherzer rolling lift bridge for the Central R. R. Co. of N. J. across Newark Bay, N. J., is rapidly nearing completion. This bridge is being erected in its closed position, and constantly carries the railroad traffic without interruption. During the past month Scherzer bridges were completed and placed in active service at 18th St., Chicago; South Michigan St., Buffalo, N. Y.; Swale River, England, for the South Eastern & Chatham Ry. During the present month the following additional Scherzer bridges will be completed and placed in active service: Union St., Third Ave. and Hamilton Ave. bridges, across Gowanus Canal, Brooklyn; long span double-leaf Scherzer bridge at Manhattan Ave., across Newtown Creek waterway, Brooklyn. The Scherzer Co. states that the double-track, single-leaf, long-span Scherzer bridge recently completed and placed in service for the N. & S. S. R. R., Cleveland, O., has attracted wide attention because of its simplicity and economy. It is being duplicated by the B. & O. R. R. Co. at Cleveland at an adjacent site, where a center-pier swing bridge is being removed and replaced. Orders for a number of additional single, double and multiple-track bridges of similar form have been booked by the Scherzer Co., construction contracts to be let this year. The contract for the construction of the Scherzer bridge for the Buffalo & Susquehanna R. R. and the Pennsylvania R. R. at Buffalo, has recently been awarded and work of construction is now in progress. Construction work is also in progress on Scherzer bridges at 22d St., Chicago; Harrison St., Chicago; Flushing, L. I.; Genesee Ave., Saginaw; over the Suir River, Ireland; Spaarne River, Holland; Saugus River, Boston; Malden River, Boston; West River at Kimberly Ave., New Haven; four-track railroad bridges for the N. Y., N. H. & H. R. R. Co. at Cos Cob, Conn.; Westport, Conn., and across the Housatonic River. Among the foreign contracts on which the Scherzer Co. is now working is a large highway bridge across the Ekaterinhofka River, St. Petersburg; also a deck bridge of arched outline, forming the movable portion of a long bridge connecting Barrow-in-Furness with Walney Island, England.

The Hydrex Felt & Engineering Co., which has just commenced business at 120 Liberty St., New York City, devotes its energies exclusively to waterproofing. This is a branch of engineering which has hitherto been comparatively neglected, but with the great activity in tunnel building, the importance of the subject now warrants the attention of specialists. This is the first company which, besides offering waterproofing material, also draws up plans and specifications and attends to the engineering details of this class of work. The manager of the new company is Edward W. DeKnight, who has taken a prominent part in preparing the plans for waterproofing a number of great engineering enterprises. The new company is an off-shoot of the old-established concern of F. W. Bird & Son, East Walpole, Mass. The Hydrex Felt & Engineering Co. starts business under favorable auspices, as hydrex felt has been specified for the Pennsylvania Tunnel under New York City, the B. & O., Pennsylvania improvements at Washington, and other important projects.

The W. W. Patterson Co., Pittsburg, reports that it expects one of the best seasons that it has ever had. Within the last two weeks the company has received large orders of blocks to repair for the following firms: Riter-Conley Mfg. Co.; Fort Pitt Bridge Works and the McClintic-Marshall Construction Co., all of Pittsburg, Pa., and a large order of new blocks from Penn Bridge Co., Beaver Falls, Pa. There is now enough work on hand to keep the factory rushed for the next two months.

H. Eilenberger & Co., Association Bldg., Chicago, have incorporated to do a general contracting business. H. A. Peters, F. H. Smith and H. F. Busching are associated with Mr. Eilenberger.

The contract for the compressed-air power plant to be used in building the second pair of trolley tunnels under the Hudson River has been awarded to the Ingersoll-Sergeant Drill Co., which furnished the compressors for the other tunnels now building under the Hudson and East rivers.

The Hennepin Bridge Co., Minneapolis, Minn., has been incorporated with a capital stock of $100,000. The incorporators are L. H. Johnson, F. H. Howe, W. W. Roberts, T. M. Thomson and C. J. Traxler.

The Cockburn Barrow & Machine Co., Jersey City, N. J., has received contract, through the Phœnix Construction Co., for the shield for the experimental freezing tunnel under the East River for the Pennsylvania R. R.

Howard F. Gurney, of Jersey City, N. J., who has for some years been connected with the Otis Elevator Co. as superintendent of construction, has secured control of the National Elevator & Machine Co., with works at Honesdale, Pa., and offices at 52 University Place, New York. Mr. Gurney has been elected president of the company; Jos A. Dear, vice-president; Robt. Carey, secretary, and F. S. Merritt, treasurer.

The Mickle-Milnor Engineering Co., whose offices have been removed to 820 Drexel Bldg., Philadelphia, has been appointed representative of the C. & G. Cooper Co. The company also represents the Herron & Bury Mfg. Co. and H. R. Heinicke, Inc.

The Quintard Iron Works have just closed contract for installation of two 60-kw. and one 30-kw. generator. The engines are to be Watertown cross compound vertical. Specifications were drawn by Bates & Neilson. The Watertown Engine Co. has also received order for engines for lighting plant of the Springfield Provision Co., at Somerville, Mass., and for 125-h.p. vertical cross compound engines for direct connection to pumping machinery for the New England Dressed Meat & Wool Co.

The Hamilton-Ewing Engine Co., Bridgeton, N. J., has been incorporated with a capital of $100,000. The incorporators are Wm. R. Hamilton, Alfred B. Ewing and Paul M. Williams.

PERSONAL NOTES.

Mr. S. Cameron Carson has been chosen borough engineer of Norristown, Pa.

Mr. John J. Clark, for twenty-five years assistant city engineer of St. Joseph, Mo., died Feb. 14.

Mr. James Clark, president of the Osgood Dredge Co., died Feb. 21, at his home in Albany, N. Y.

Mr. F. A. Molitor has been appointed chief engineer of the Midland Valley Ry., with headquarters in St. Louis.

Mr. James G. Wetmore has been reappointed superintendent of the Union City, Mich., municipal water works and electric lighting plant.

Mr. John E. Waller has been appointed county surveyor of Terrel County, Ga., to fill the vacancy caused by the recent resignation of Mr. J. S. Spear.

Mr. John W. Boardman has resigned as treasurer of the Southern States Portland Cement Co., Atlanta, Ga., and expects to return to Jackson, Mich.

Mr. Lewis T. Haney will deliver paper entitled "Precise Leveling; a Description of the Instruments, Methods and Results," before the Brooklyn Engineers' Club, March 9.

Mr. N. P. Sproull, superintendent of the Central Railroad of New Jersey shops at Elizabethport, N. J., has been appointed master mechanic of the Atlantic Coast Line with jurisdiction over the Savannah district.

B. A. Schroder, for some time attached to the St. Louis office of the Crocker-Wheeler Co., has been placed in charge of the New Orleans office of the company. Mr. Schroder succeeds W. P. Field, who has been transferred to the Boston office.

Mr. Wm. B. Wheeler has been appointed general manager of the railroad and marine department of Toch Bros., of New York, with his headquarters in the Fisher Bldg., Chicago. Mr. Manton B. Parker is connected with that department in the New York office.

Mr. Eugene F. Phillips, general manager of the American Electrical Works and president of the Washburn Wire Co., died suddenly on Feb. 20, at his home in Providence, R. I. Mr. Phillips was the pioneer manufacturer of insulated telegraph wire in this country.

Mr. George Reyer formerly superintendent of the Nashville, Tenn., water works and afterward in the same position in Birmingham, Ala., has been appointed superintendent of the water works system which supplies Mt. Vernon and Marmarnoack, N. Y., and surrounding territory.

Mr. John W. Ferguson, of Paterson, N. J., has announced that the building and general contracting business which he has conducted personally for the past twelve years has been transferred to The John W. Ferguson Co. The new company will continue the business as heretofore, assuming all of its liabilities and assets.

Mr. John McLeod has resigned from the presidency of the Association of American Steel Manufacturers and Mr. H. H. Campbell, general manager of the Pennsylvania Steel Co., Steelton, Pa., has been elected to succeed him. Mr. W. A. Bostwick, of Pittsburg, has been elected vice-president of the association.

On account of the retirement of Col. David P. Heap, Corps of Engineers, U. S. A., with the rank of brigadier-general, the following engineer officers have been nominated to be advancd in grade: Lieut.-Col. Thomas H. Handbury, Major Daniel C. Kingman, Capt. Francis R. Shunk, First Lieut. Norton W. Stickle, and Second Lieut. Richard C. Moore.

Mr. Chas. G. Hyde, resident engineer in charge of the construction of the Harrisburg, Pa., filtration plant, has been visiting the Columbus, O., sewage testing station and studying water filtration works in the middle west prior to his departure in June to take up the professorship of municipal and sanitary engineering in the University of California.

The John Peirce Co., 227 Broadway, New York City, has assumed the granite and general contracting business formerly carried on by Mr. John Peirce, and also the business of the New York & Maine Granite Paving Block Co. The western office of the company will be under the management of Mr. George T. Bodwell, 508 Western Union Bldg., Chicago.

Mr. J. W. Wood, chief engineer of the new city hall in St. Louis, Mo., has been engaged to act as consulting and erecting engineer of a municipal electric lighting station at Terre Haute, Ind. He will retain his position in St. Louis. Mr. J. T. McCulloch, of McCulloch & Co., Security Bldg., St. Louis, will have charge of the installation of the electrical equipment of the Terre Haute plant.

Mr. Campbell Scott, for many years prominent in the management of the C & C Electric Co., and whose resignation from that company was recently announced in this column, has been appointed manager of the main works of the Otis Elevator Co., at Yonkers, N. Y. Mr. Scott has had considerable experience as a works director, and is specially qualified for the duties he has assumed.

Mr. F. L. Stuart, engineer of surveys of the Baltimore & Ohio R. R., has been appointed chief engineer of the Erie R. R. Mr. W. L. Derr, who has been acting as chief engineer of the Erie R. R. for some time, has been appointed superintendent of the Susquehanna division. Mr. Harry R. Talcott, assistant engineer of the Baltimore & Ohio R. R., at Cumberland, Md., has been appointed engineer of surveys of that road to succeed Mr. Stuart.

Mr. Lee Treadwell has become associated with The Foundation Co., of New York City, and will be superintendent in active charge of the company's work in connection with the terminals of the Frisco R. R. at Chalmette, near New Orleans. This and other western work, will be under the general supervision of Mr. George Adgate, western manager of The Foundation Co. The large granite dry dock for the United States government at Portsmouth, N. H., for which Mr. John Peirce was the contractor, and Mr. Treadwell the resident superintendent, has been completed.

The following candidates for admission to the American Society of Civil Engineers were elected March 1: As Members: Hiram B. Andrews, Engr. for Simpson Bros. Corporation, Boston, Mass.; Bion J. Arnold, Cons. Engr., Chicago, Ill.; Henry J. Burt, Contr. Mgr., American Bridge Co., address, Salt Lake City, Utah; William H. Chadbourn, Jr., U. S. Asst. Engr., Beaver, Pa.; Charles R. Coutlee, in charge of Ottawa-Montreal Dist. of Georgian Bay Ship Canal survey, Ottawa, Ont., Canada; Frank M. Haines, 2d Vice-Pres. and Gen. Mgr., Northern Texas Traction Co., Fort Worth, Tex.; George F. Hardy, Mill and Hydr. Engr., New York City; Guy Moulton, Res. Engr., New York State Barge Canal, Syracuse, N. Y.; William H. Penfield, Engr., Western Pacific Ry. Co., San Francisco, Cal.; Cornelius Van V. Powers, Div. Engr., 3d Div., Board of Rapid Transit Comrs., New York City; Henry W. Rockett, with Existing Lines Branch, Railway Dept., Western Australia, Perth, Western Australia; Cecil B. Smith, Toronto, Ont., Canada; Frank Soulé; Prof. of Civil Engineering, Dean of Col. of Civil Engineering, Univ. of California, Berkeley, Cal.; William F. Strouse, Asst. Engr. in charge of Baltimore & Ohio R. R. Co.'s portion of Washington Terminal Improvement, Washington, D. C. As Associate Member: Charles B. Burdick, associated with John W. Alvord, San. and Hydr. Engr., Chicago, Ill.; Charles Enzian, Asst. to Div. Engr., Lehigh Valley Coal Co., Wilkesbarre, Pa.; Arthur B. Foote, Asst. Supt., North Star Mines Co., Grass Valley, Cal.; James W. Gallagher, Foreign Engr. for The Lorain Steel Co., address, London, England; Lewis T. Haney, Brooklyn, N. Y.; Richard W. How, Chf. Inspector (Bridge Engr.'s office), Long Island R. R., Brooklyn, N. Y.; Isaac W. Hubbard, Pugh & Hubbard, Philadelphia, Pa.; Thomas C. Moorshead, Chf. Engr., Illinois Terminal R. R., Alton, Ill.; Lewis J. Proctor, Asst. Supt. Bureau of Public Works of Porto Rico, San Juan, Porto Rico; Harry H. Rankin, Rankin & Hengst, Pittsburg, Pa.; George C. Saunders, Mgr. Eastern Dist. The Osborn Engineering Co., Philadelphia, Pa.; Courtland E. Smith, Asst. Engr., Aqueduct Comrs., New York City, New Croton Dam Div., address, Ossining, N. Y.; Clinton G. Wells, City Engr., Galveston, Tex. As Associate: Thomas H. Letson, New York Mgr., American Hoist & Derrick Co., of St. Paul, Minn., address, New York City; Domingo A. Usina, Attorney and Counsellor-at-Law in Patent Cases, New York City. The transfer of the following candidates was made by the Board of Direction, on Feb. 28, 1905: From Associate Member to Member: Maurice F. Brown, Boston, Mass.; Walter R. Marden, Albany, N. Y.; Charles H. Nichols, New Haven, Conn. The following candidates were elected by the Board of Direction, as Juniors: On Jan. 3, 1905, Ramiro F. A. Ferradas, New York City; on Jan. 31, 1905, Clyde W. McCornack, Phoenixville, Pa.; on Feb. 28, 1905, Lester Bernstein, Clifton Mills, W. Va.; Harry O. Garman, West Lafayette, Ind.; Francis F. Longley, Watertown, N. Y.; James C. Park, Watertown, N. Y.; George E. Pellissier, Holyoke, Mass.; Carl R. Weidner, Independence, Kans.

CONTRACTING NE

OF SPECIAL INTEREST TO

CONTRACTORS, BUILDERS, ENGI
AND MANUFACTURERS

OF ENGINEERING AND BUILDING SUPP

WATER.

Notes Arranged Alphabetically by S

Roosevelt, Ariz.—The lowest bid op
Feb 2. by the U. S. Reclamation Se
Phoenix, for constructing the Roose
for storage and irrigation water on
Salt River, was submitted by J.
O'Rourke, of Galveston, for $1,147,6
completed in 2 years.

Tucson, Ariz.—It is reported that
Council has under consideration the
$250,000 bonds to be used as follows:
creasing the water supply, improven
parks, laying new sewer, and for t
tion of new city hall and jail.

Gravette, Ark.—J. F. Dorsett, Ci
writes in regard to the construction o
works, that it has not yet been
whether to build until committee
estimates.

**Chico, Cal.*—The Chico Water Co.
that the Chicago Iron & Bridge Co.,
cago, Ill., has secured the contract fo
ing a steel water tower at Chico.

Empire, Colo.—See "Power Plants,
Electricity."

Meeker, Colo.—The date of opening
for furnishing material and const
water works has been extended from
to Mar. 20, as advertised in The Engi
Record. Specifications on file at the
The Engineering Record.

New Haven, Conn.—E. Whitney, Pr
Haven Water Co., writes that it has n
definitely decided yet to construct a
voir in Woodbridge Ravine; no speci
or surveys have been made.

South Norwalk, Conn.—Local press
state that the following are the bids
on Feb. 15 by the Water Comrs. for
plant to be constructed at Wilton:
Constr. Co., New York, N. Y., $75,000
Wardwell & Co., Stamford, $66,800;
Palmer, Boston, $73,485; Standish St
Bridgeport, $76,742; Aberthaw Cons
Boston, $81,827, and Simpson Bros.,
Mass., $86,288.
Local press reports state that the
Comrs. have decided to ask for revis
on the above work, eliminating the c
tion of the secondary filter; approp
for the work is said to amount to $5

Washington, D. C.—Bids are wante
18 for furnishing 600 tons 8-in. c. i
pipe, as advertised in The Engineeri
ord.

Elgin, Ill.—The Council is reported
voted to appropriate $10,000 for the
of a standpipe.

Ridgeville, Ind.—See "Power Plan
and Electricity."

Frankfort, Ind.—Local press report
that the Council has passed a resolut
thorizing the appointment of Geo. W.
vant, of Chicago, Ill., to make surve
looking to the construction of munici
ter works. The contract with the Fr
Water Co. expires Jan. 1, 1906.

Odon, Ind.—See "Power Plants, G
Electricity."

Stanton, Ia.—The question of const
water works is reported under consid
here.

Mansfield, La.—Bids will be receive
May 14 by the Mayor and Bd. of Ald
for constructing a system of water
as advertised in The Engineering Rec

**Ft. McKinley, Me.*—Capt. A. W.
Q. M., U. S. A., Portland, writes that t
tract for furnishing and installing a
pump in pump-house here (bids opene
15) has been awarded to O. M. & D. W
of Portland, for $1,137.

Baltimore, Md.—Local press report
that plans for a system of high pressu
mains for Baltimore have been com
under supervision of Chief Engineer
and the total cost is estimated at $395,
The proposed line is to cover the
bounded by Eutaw St. and Jones Fal
Lexington and Barre Sts.

Springfield, Mass.—The Water Com
reported to be considering the establi
of a temporary filter at Ludlow for u
ing the coming summer; the cost of
plant, with engines to pump water
beds, is estimated at between $40,0
$50,000.

Falmouth, Mass.—The Water Com
stated to have been authorized to
Legislature for permission to issue
bonds for extending the water mains
Falmouth.

Boston, Mass.—Water Comr. Sullivan
ported to have opened the following
Feb. 21:
Cast-iron water pipes, 2,000 tons,
sizes—Warren Fdry. Co., Phillipsburg,
$50,892; U. S. Cast Iron Pipe & Fdr
Philadelphia, $59,049, and Camden Iro
Camden, N. J., $54,710.
Iron castings, 830,000 lbs., various
Foxboro Fdry. Co., Boston, $22,300;
Fdry. Co., East Boston, $22,966, and
Farnham Mfg. Co., Waltham, Mass.,
Composition castings, 20,000 lbs.,
kinds—J. H. McCafferty & Co., Bosto
636.

**Items marked thus give the names of parties awarded contracts.*

en, Mass.—Henry W. Warren, Chmn. Comrs., writes that bids will be opened . 20 for laying about 6 miles of c. i. ipe

naba, Mich.—The Escanaba Water Co. orted to have decided to expend about 0 in improvements. W. J. Hatton, up

na, Mich.—See "Power Plants, Gas nd ectricity."

nd Rapids, Mich.—City Engr. L. W. An- is stated to have on Feb. 17 presented Bd. of Pub. Wks. amended plans and tes for going up-river for a pure water in connection with mechanical filtra- eds; the total cost involved is $698,800. vork includes intake, $20,000; infiltra- galleries, $43,500; pumping station, s and connections up-river, $22,000; fil- nd pure water reservoir, $256,000; land, 0; gravity conduit, $150,900; low lift s, generators, etc., $80,000; pumps and ctions at present pump house, $100,000, oundations and changes in suction, $10,-

ndon, Mich.—R. A. Bowie, Village Clk., s that an election will be held Mar. 13 te on the question of constructing wa- orks, at a cost of $15,000.

ıre, Mich.—G. E. Benner, City Clk., s that contracts will probably be let time in March for water works, to cost $17,000.

atonna, Minn.—See "Power Plants, Gas Electricity."

. Paul, Minn.—L. W. Rundlett, Comr. of Wks., in his annual report recommends r-works improvements, to include: Ex- ng conduit between Pleasant and Sucker s, to the White Bear Road, $8,000; re- truction of flume line between Pleasant and end of conduit at Wilkinson Lake, 0; renewal of Otter Lake gate chamber, permanent construction, $2,500; repairs ooden pipe conduit from Centerville Lake, 00, and for protection of wells and re- of conduits around Centerville Lake, 000.

eenbush, Minn.—It is reported that bids be received Mar. 7 by the Village Re- er, for constructing a 60-ft. tower and 0-bbl. tank.

inneapolis, Minn.—It is stated that bids be received until Mar. 10 by the City Clk., 28 tons 6 to 16-in. c. i. pipe, 95 hydrants, valves and 22 tons special castings. rew Rinker, City Engr.

assville, Mo.—Reports state that bids will eceived Apr. 1 by E. C. Frost, Mayor, for 00 water-works bonds.

t. Assinniboine, Mont.—Bids are wanted . 25 for furnishing and installing all pip- fittings, valves, stops, etc., required, a .-p. boiler, stack with breeching and roof tilator, duplex pump, boiler-feed pump, a l-water heater with exhaust head, also ut 3,050 ft. 6-in. and 650 ft. 4-in. c. i. and spigot water pipe. Capt. J. B. Mc- ald, Constructing Q. M.

ambridge, Neb.—Chas. Mousel, City Clk., tes that the probable cost of water works posed will be bet. $10,000 and $15,000. gineer, W. H. Faling, Cambridge.

lma, Neb.—See "Power Plants, Gas and ctricity."

harlestown, N. H.—The State Senate is orted to have passed the bill to incorpo- e the Charlestown Water & Sewer Co.

Delawanna, N. J.—A. J. Van Brunt, Secy.- as. Yantacaw Water Co., writes that wa- works are to be constructed here. Local ople are interested. Engineer, Colin R. se, of Passaic.

Atlantic City, N. J.—Bids will be received the Bd. of Water Comrs. on Mar. 28 for nstructing a coal pocket, coal elevating ma- inery, a machine shop and tool house, as vertised in The Engineering Record. Plans d specifications on file at office of Engineer- Record.

Binghamton, N. Y.—The Norwood Eng. ., Florence, Mass., is stated to have secured e contract for an auxiliary pump for the ter works at $2,565.

**Schoharie, N. Y.*—The following are the ds opened on Feb. 22 for the con- ruction of water works (Knight & opkins, Engrs., Rome): J. Vaughn, Stam- rd, N. Y., $23,932 (awarded contract); hn Doyle, Albany, $24,826; C. R. Lewis, on, $25,398; John Marsden, Utica, $25,600; meron-Hahn Realty Co., Albany, $25,980; H. Eldridge, Ossinning, $26,248; M. Fitz- erald, Hoosic Falls, $26,453; Clinton Beck- ith, Herkimer, $26,600; Young & Woods, racuse, $26,800; Frank Bisch, Troy, $27,- 71; DeWitt G. Nash, Albany, $27,304; oxley & Co., Jefferson, $27,389; Troy Pub- c Wks. Co., Utica, $27,500; S. M. Neff Co., . Y. City, $27,627; Ellery, Colby & Co., wego, $27,700; Denniston & Co., Rochester, 28,182; A. A. Parker, Waterford, $28,225; ammond & Sloane, N. Y. City, $28,531; rank Pidgeon, Saugerties, $28,659; Sewan- n & Callahan, Jamestown, $29,114; J. L. itzGerald, Albany, $29,728; Karg & Van est, Johnstown, $29,825; Richards & Gas- n, N. Y. City, $31,955.

**Syracuse, N. Y.*—F. T. Pierson, Clk. Bd. ontract and Supply, writes that the con- ract for 365 tons 6, 8, 10 and 12-in. c. i. ater pipe and 9 tons of special castings bids opened Feb. 14) has been awarded to has. Millar & Son Co., of Utica, N. Y., for 10,068.

Bids will be received until Mar. 6 by the d. of Contract & Supply, for furnishing 50 ate box tops, with covers and chains, 50 overs and chains for gate boxes, 200 iron aucers for gate boxes, 100 box extensions, 25 gate stones, of gray limestone, and 30,000 b. of soft pig lead. Fredk. T. Pierson, Clk.

Albany, N. Y.—The Common Council has approved the bill recently passed by State Legislature providing for a bond issue of $400,000, to build an addition to the filtration plant.

Buffalo, N. Y.—The House of Representatives has passed the bill authorizing the city to construct a tunnel under Lake Erie and Niagara River for the purpose of supplying pure water to the city.

**Louisburg, N. C.*—G. O. Tenney, of Augusta, Ga., is reported to have secured the contract for constructing water works, for about $60,000.

Spencer, N. C.—The Bd. of Aldermen is stated to have granted Wm. P. Lockwood, of Washington, a 50-yr. franchise for the construction and operation of a water-works. Probable cost of plant, $50,000. Engineer, Francis R. Weller, of Washington, D. C.

Oakes, N. D.—It is reported that bids will be received Mar. 25 by W. S. Wickersham, City Aud., for a system of water mains and sewerage.

Cleveland, O.—Specifications are on file at the office of The Engineering Record for stop-cock boxes and parts of same that may be required during the year 1905, bids for which will be opened by A. R. Callow, Secy. Dept. of Public Service, on Mar. 13.

Geneva, O.—C. I. Crowther, City Clk., writes that bids will be received on Mar. 27 for $10,000 bonds, to be used for water-works improvements.

Youngstown, O.—W. Hamilton, Supt. Water Wks., is stated to have completed plans for a high pressure service main from Belmont Ave. standpipe to the east end; he estimates the cost at $12,000.

Barnesville, O.—Bids will be received Mar. 23, by the Bd. Trus. of Pub. Affairs, J. W. Doudna, Pres., for furnishing material, constructing and delivering f. o. b. Barnesville, two 60 in. by 16 ft. tubular boilers with setting irons and fittings; 80 h.p. closed feed water heater, and a duplex or equivalent boiler feed pump; also for hauling and bricking up said boilers. Chapin & Knowles, Engrs., Central Savings Bank Bldg., Canton.

**Philadelphia, Pa.*—F. J. Shoyer, Dir. Dept. of Supplies, writes that the Camden Iron Wks. has secured the contract for furnishing 3, 4, 6, 12, 16, 20, 30, 36 and 48-in. c. i. pipe, and the Donaldson Iron Co. has secured the contract for 6, 8 and 10-in. c. i. pipe and for small and large specials, breeches pipe, quarter turns, 20 to 48 in. and machine work (bids opened Feb. 20).

Allegheny, Pa.—See "Sewerage and Sewage Disposal."

Mars, Pa.—J. A. Gilbert, Jr., Clk. of Council, writes that it was voted Feb. 21 to issue $11,500 bonds for water works.

Jamestown, Pa.—The Borough Council is stated to have authorized the construction of a gravity water-works system, to cost $16,000. A special election will be held soon to vote on a bond issue.

Sykesville, Pa.—The Sykesville Water Co., of Sykesville, has been incorporated; capital, $5,000. Directors: S. B. Long and Jacob B. Sykes, of Sykesville, and others.

Riverside, Pa.—The Riverside Water Co. is reported incorporated, with a capital of $20,000, by T. J. Mitchell and Frank Bradford, of Connellsville, and J. B. Henderson, of Vanderbilt. The company will furnish the Revere Works with water from the Oliver Iron & Steel Company's mains.

Ft. Sill, Okla. Ter.—Bids are wanted Mar. 29 for installing a water distributing system at this post. Robt. R. Stevens, Ch. Q. M., San Antonio, Tex.

Pittsburg, Tex.—The Arkansas & Texas Ice & Coal Co., of Pine Bluffs, Ark., is reported to have secured a franchise at Pittsburg, for a water works and will put in a plant to cost $25,000.

Tacoma, Wash.—There has been an estimate made for water extension to cost $500,000, to consist of 2 reservoirs, 2 stand pipes, 21 wells, power house, with 2 miles of 24-in. c. i. pipe and several miles of wooden pipe. This is to be submitted to vote April 6. E. I. Salmson, Chmn. Special Com. of City Council. F. L. Davis, City Engr.

Bellingham, Wash.—It is stated that bids will be received Mar. 13 for furnishing and installing 75 h.p. electric pumping plant consisting of generator, motor and turbine pump and 5,200 ft. of wire. Probable cost $3,500. Geo. M. Gerhard, City Engr.

Ft. Flagler, Wash.—Bids are wanted Mar. 13 for furnishing and laying approximately 6,675 ft. 6-in. c. i. pipe at this post. Geo. H. Penrose, Q. M., U. S. A., Port Townsend.

Blaine, Wash.—The Monarch Lumber Co. is reported to have secured a franchise for water works.

**Seattle, Wash.*—The following are the bids opened by the Bd. of Pub. Wks., Feb. 18, for furnishing material and laying a water main on Phinney Ave.; 47 gates are also included in the total; (*a*) Pacific Coast Pipe Co., 625 1st Ave., total, $28,225 (awarded contract); (*b*) F. M. Stanley, Burke Blk., $35,512; (*c*) Bell & Price, Walker Bldg., $34,570:

	**a.*	*b.*	*c.*
Fixed estimate	$1,200	$1,200	$1,200
9,095 ft. 16-in. pipe‡	1.15	1.70	1.40
22,315 " 8-in. " ‡	.62	.73	.78
1,200 " 2-in. " †	.30	.33¾	.30
31 c.-i. valve boxes	5.50	5.25	7.00
8,350 lb. special castings	.05½	.05½	.07
100 yd. extra excav	1.00	.45	1.00

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‡16 and 8-in. wooden machine-banded pipe.
†2-in. wrought iron galvanized pipe.

West Allis, Wis.—Press reports state that it is proposed to extend the high pressure water service pipes of Milwaukee to West Allis. The city of Milwaukee will extend the high pressure service from 35th St. and Grand Ave. through the Menominee valley as far as Silver City, The pipes will go as far as the factory of Pawling & Harnishfeger, and from this point on the officials of West Allis will lay their own pipes. The inhabitants of Silver City will also be relieved by the extension of the high pressure service. The entire cost to the city of Milwaukee for extending the mains will be $15,000, and the village of West Allis will expend about $60,000 for the work.

**Milwaukee, Wis.*—The contract for furnishing 1,600 tons 4, 6, 12 and 14-in. c. i. water pipe (bids opened Feb. 24) has been awarded to the U. S. Cast Iron Pipe & Fdy. Co., of Chicago, Ill., at $26.85 per ton; total cost, $42,960.

Green Bay, Wis.—The Green Bay Water Co. is reported to be considering the matter of an increased water supply.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Tucson, Ariz.—See "Water."

San Francisco, Cal.—The Supervisors are stated to have sold bonds on Feb. 21, to be used as follows: Sewers, $281,200; street work, $243,000; county jail and Hall of Justice, $278,400; schools, $650,600, and hospital, $250,000.

Santa Monica, Cal.—The City Trus. are stated to have passed an ordinance providing for an issue of $20,000 bonds to construct a septic tank and main sewer trunk line.

New Britain, Conn.—The Sewer Dept. is in the market for 2 trenching machines.

Washington, D. C.—A. E. Phillips, Acting Supt. of Sewers, writes that the U. S. Cast Iron Pipe & Fdy. Co., of Philadelphia, Pa., bid on Feb. 20 for furnishing two 60-in. flanged specials, $182.45, and sixteen 60-in. bell and spigot specials, $144.20.

Freeport, Ill.—The Bd. of Local Improv. is considering the advisability of constructing Sewer Dist. No. 5, comprising about 12 miles of pipe sewers. G. W. Graham, City Engr.

Chicago, Ill.—Bids will be received Mar. 7 by the Bd. Local Improv. for constructing vitrified tile pipe and brick sewers in portions of numerous streets; also for constructing house drains in portions of several streets. John A. May, Secy.

Des Moines, Ia.—Bids will be received until Mar. 21 by the Bd. Pub. Wks. (W. W. Wise, Chmn.), for constructing 1,064 ft. of 24-in. vitrified clay pipe sewer in Willow St.

Salem, Mass.—The Bd. of Aldermen is reported to have on Feb. 23 passed an order appropriating $110,000 for new sewers.

Fulton, N. Y.—Bonds to the amount of $10,000, to be used for the west side sewer, have been sold.

**New Rochelle, N. Y.*—Local press reports state that the following are the bids opened by the Bd. of Sewer Comrs. for the construction of the under water part and the sand catcher, which are to be part of the sewer outlet of this city: Neff Co., $108,400; Richard C. Gaston, $106,353, and Seely-Taylor Co., $77,622 (awarded contract).

Saratoga Springs, N. Y.—It is stated that bids are wanted Mar. 7 for constructing a sewer. H. F. Thomas, Clk.

**Mamaroneck, N. Y.*—Chas. W. Buckten, Village Clk., writes that the contract for constructing 3½ miles of sewers (bids opened Feb. 17) has been awarded to M. Decioccoto, Larchmont, for $19,046.80.

Buffalo, N. Y.—The Com. on Sewers of the Bd. of Aldermen is stated to have on Feb. 21 voted to reject all bids received for the proposed Virginia St. sewer and to build a storm sewer to give the needed relief; the lowest bid received for the work is reported to have amounted to $68,500.

Portsmouth, O.—Benj. Bratt, City Engr., is reported to have completed plans for a flood defense sewer; he estimates the cost at $7,000, which includes the pumping station.

**Chillicothe, O.*—H. M. Redd, City Engr., writes that contracts for constructing pipe sewers (bids opened Feb. 20) have been awarded as follows: For High and Hickory Sts., to Jardine & Co., of Chillicothe, for $5,428, and for Vine, Plum and Chestnut Sts., to Pfaff, Ringwald & Smith, of Chillicothe, for $4,852.

**Cleveland, O.*—Contracts for the construction of sewers are stated to have been awarded by the Bd. of Pub. Service on Feb. 17 as follows: To Beers & Doolittle, for sewers on Norwood St. and Ambleside Ave., $48,053, and to Wm. Lehman, for sewers on Doan, Sargent and Prague Sts., and Rhodes, Schley and Auburndale Ave., for $20,421.

Bids opened on Feb. 17 for constructing a sewer on Milford St. are reported to have been rejected, and new bids will be received. The lowest bid received amounted to $28,453.

Warren, Pa.—The citizens are reported to have voted Feb. 21 to issue $25,000 bonds for extending the sewerage system and for better equipment for the fire department.

Allegheny, Pa.—The citizens are reported to have voted Feb. 23 to issue bonds as follows: For improvement of streets and construction of sewers, $420,000; extension of water system, $225,000; regrading and repaving of streets and for payment of damages occasioned by elevation of tracks of Pennsylvania Co., $125,000; repairs and improvements to city parks, $90,000; new engine house in 10th ward, $25,000, and $25,000 for building porches at Allegheny City Home.

Mt. Carmel, Pa.—The citizens are reported to have voted Feb. 20 to issue $50,000 bonds to complete the sewerage system.

Coldwater, Mich.—Chas. G. Moore, City Engr., writes that the following are the bids opened on Feb. 21 for completing trunk sewers; on about half the work ground water will be encountered from 2 to 4 ft. above grade; (*a*) Stitt & Kunse, Wabash, Ind.; (*b*) National Constr. Co., South Bend, Ind.; (*c*) W. W. Hatch & Sons, Goshen, Ind.; (*d*) M. A. Talbott & Co., Logansport, Ind.; (*e*) O'Shea & Shea, Hammond, Ind.:

Sewer pipe laid:	*a.*	*b.*	*c.*	*d.*	*e.*
360 lin. ft. 24-in. (embankment)	$1.43	$1.65	$3.15	$2.50	$1.87
2,716 " 18-in., average depth, 15.0 ft.	3.55	3.35	3.07	4.80	3.41
2,940 " 15-in., " " 19.5 "	2.61	2.90	3.23	3.50	2.91
3,060 " 12-in., " " 17.8 "	1.92	2.25	2.53	2.00	2.23
1,000 " 10-in., " " 14.9 "	1.13	1.50	2.07	1.60	1.51
20 manholes	37.00	44.00	50.00	45.00	35.00
Totals	$25,575	$27,483	$30,780	$32,857	$27,524

Lansing, Mich.—The following are the bids opened on Feb. 27 for constructing Weinman Creek Valley sewer, in Pine and other streets: I. H. Algate, Lansing, $17,934, and M. E. Fitzpatrick, Lansing, $19,500.

St. Paul, Minn.—L. W. Rundlett, Comr. of Pub. Wks., in his annual report is stated to have recommended improvements to the sewerage system as follows: Atwater St. extension, $25,000; sewers in Como Park and Warrendale Dist., about $15,000; Trout Brook Sewer below 3d St., $5,000; the completion of the St. Anthony Park sewerage system, and other sewers.

St. Joseph, Mo.—City Engr. W. M. H. Floyd, Jr., is reported to have field forces at work surveying for sewer extensions and a new main sewer in South St. Joseph. Bids for construction will probably soon be asked.

Charlestown, N. H.—See "Water."

Woodstown, N. J.—The question of constructing a sewerage system is reported under consideration here.

Brooklyn, N. Y.—Bids will be received Mar. 15 by Martin W. Littleton, Boro. Pres., for furnishing material and constructing sewer in portions of Beverley Road. Engineer's estimate: 1,590 lin. ft. 12, 15, 18 and 24-in. pipe sewer, 15 manholes, 10 sewer basins, etc.

Bids will be received Mar. 8 (change of date) by Martin W. Littleton, Boro. Pres., for furnishing material and constructing sewer in a portion of 76th St., bet. 4th and 6th Ave., requiring 810 ft. 12 in., 45 ft. 15 in. and 815 ft. 18 in. pipe sewer, 16 manholes, and 3 sewer basins, and for furnishing a sewer basin in Barbey St. and Arlington Ave., Palmetto St. and Evergreen Ave., and Oakland and Ash Sts.; also for furnishing, delivering, housing and trimming 6,750 bbls. quicklime at several sewage disposal works in 26th, 31st and 32d wards.

Bids will be received Mar. 15 by Martin W. Littleton, Boro. Pres., for furnishing material and constructing sewer in a portion of E. 67th St., with outlet sewers in 3d Ave.; engineer's estimate 2,221 lin. ft., 30, 36 and 42-in. reinforced concrete sewer, 710 lin. ft. 12-in. and 45 lin. ft. 15-in. pipe sewer, 27 manholes, 5 sewer basins, etc.

**Houston, Tex.*—F. L. Dormant, City Engr., writes that the contract for constructing 6,000 ft. 24-in. pipe sewers on Louisiana St. (bids opened Feb. 6) has been awarded to J. C. Kelso, of Galveston, for about $15,476.

Ft. McIntosh, Tex.—Bids are wanted Mar. 29 for constructing a sewerage system at this post. Robt. R. Stevens, Ch. Q. M., San Antonio, Tex.

Seattle, Wash.—The following are the bids opened on Feb. 18 by the Bd. of Pub. Wks., for a sewer and septic tank on 10th Ave, N. E.; (*a*) Stirrat & Goetz, 410 Washington Bldg., total, $9,950; (*b*) T. Ryan, Seattle, Wash., total $8,893:

	a.	*b.*
Fixed estimate	$550.00	$550.00
3,500 ft. 8-in. pipe sewer	1.25	1.07
1,600 " 12-in. pipe sewer	1.40	1.15
200 " Tile drain, 5-ft. dp.	.50	.70
60 " 8-in. c.-i. pipe	3.00	1.30
19 4½-ft. manholes	65.00	70.00
4 catchbasins, sngle inlet	65.00	60.00
10 yd. concrete	1.00	7.00
Lump sum—septic tank	1,000.00	900.00

Winnipeg, Man.—Bids will be received Mar. 14 by the Chmn. Com. of Wks. for furnishing a quantity of sewer pipe and junction, as advertised in The Engineering Record.

BRIDGES.

Notes Arranged Alphabetically by States.

Phoenix, Ariz.—The Gila bridge of the Maricopa, Phoenix & Salt River Valley R. R. Co. (M. O. Becknell, Supt.) is reported destroyed by the flood.

San Francisco, Cal.—The City Engr., Woodward, has been directed to prepare an estimate of the cost of constructing a bridge at San Jose Ave. and Mt. Vernon St.

Bridgeport, Conn.—See "Railroads."

Hartford, Conn.—The House of Representatives has passed a bill authorizing the construction of a drawless bridge over Connecticut River between Hartford and East Hartford.

****Items marked thus give the names of parties awarded contracts.***

Swainsboro, Ga.—All bridges on Ohoopee River in Emanuel and Tattnall Counties are reported destroyed by the floods.

Columbus, Ga.—Bids will be received until Apr. 4 by the Bd. of Comrs. of Roads & Revenues, for the Co. of Muscogee, at Columbus, for furnishing material and constructing 2 steel highway bridges and piers across Randall's Creek, 1 known as the Johnson Bridge, to have 1 span 110 ft. long and 54 ft. steel approaches, and the other, Odom Bridge, to have 1 span 125 ft. long and 54 ft. steel approaches. Wm. Reed, Jr., Ordinary.

Richmond, Ind.—It is stated that plans are being prepared for the construction of a viaduct in W. 2d St., the city and railroad company each to pay ½ of the cost.

Indianapolis, Ind.—Bridge bonds, amounting to $170,000, are reported sold.

Des Moines, Ia.—John W. Budd, City Engr., writes that bids will be received on Mar. 18 for the construction of 2 reinforced concrete arches and 2 retaining walls to be built at the north end of present Sixth Ave. Melan Bridge; estimated cost $25,000; roadway 30 ft., two 6-ft. sidewalks. Work to commence on or before Apr. 10 and be completed Aug. 1.

Cedar Rapids, Ia.—H. S. Keffer, City Recorder, writes that it is proposed to construct a bridge over Cedar River at 2d Ave. It will be a steel-concrete arch structure of 8 spans, divided by an island, which will make two structures of 322½ ft. in length of 4 spans each; roadway, 30 ft.; walks, 6 ft.; total width from rail to rail, 43 ft.; height, 23 ft. above low water; probable cost, $80,000. Each bidder is to furnish own plans based on specification on file at Cedar Rapids. Plans submitted will be referred to some disinterested engineer for approval. W. W. Chery, Chmn. Bd. Pub. Wks., has matter in charge.

**Topeka, Kan.*—Wm. Neville, of Plattsmouth, Neb., is stated to have received the contract for constructing a bridge along the line of the Topeka & Northwestern R. R. between Marysville and Topeka; probable cost of structure $50,000.

Erlanger, Ky.—G. B. Nicholson, of Cincinnati, O., Ch. Engr. Cincinnati, New Orleans & Texas Pacific Ry. Co., writes it is proposed to replace bridges at Erlanger as follows: No. 9 bridge will be double track, 850 ft. long, 80 ft. high, estimated cost, $200,000; and No. 10 bridge will be a double-track, 555 ft. long and 75 ft. high, and cost $125,000. They will replace single-track viaducts built in 1876. New structures to be for heavy loads.

Shreveport, La.—M. L. Lynch, of Tyler, Tex., Ch. Engr. Shreveport Bridge & Terminal Co., writes that the contract has not yet been let for constructing the superstructure of the bridge over Red River at Shreveport. The Missouri Valley Bridge & Iron Wks., of Leavenworth, Kan., recently secured the contract for the substructure; total cost of construction, $250,000.

Wiscassett, Me.—The construction of a bridge between Wiscassett and Edge Comb, Lincoln County, is reported under consideration.

Pittsfield, Mass.—It is stated that the Bd. of Pub. Wks. is in favor of constructing an iron bridge over the Boston & Albany R. R. tracks at 2d St.; probable cost of structure $15,000.

Elk River, Minn.—Bids are wanted Mar. 11 for furnishing material and constructing the substructure and superstructure of a steel bridge over Mississippi River, bet. village of Elk River and town of Otsego; said bridge to have steel approaches and roadway 18 ft. in clear. G. D. Heuring, Chmn. Supervs., Otsego. A. H. Nickerson, Pres. Village Council, Elk River.

Albany, N. Y.—It is stated that the Utica & Mohawk Valley Ry. (Michael W. Martin, Ch. Engr., Utica) will construct a bridge over Erie Canal at Frankfort Junction.

Poughkeepsie, N. Y.—The New York, New Haven & Hartford R. R. Co. (Colin M. Ingersoll, Ch. Engr., New Haven, Conn.), which recently acquired the Poughkeepsie bridge, is stated to have engineers at work examining the structure to ascrtain what repairs are needed; the probable cost of improvements is $200,000.

Buffalo, N. Y.—The following are the bids opened by the Bd. of Pub. Wks. on Feb. 23. for constructing the substructure of a bascule bridge across Buffalo River. (*a*) gross sum, whole work; (*b*) rock excav. per cu. yd., including stripping (sub-marine), (*c*) dry dock wall, per lin. ft., including crib found. and excav. (Prices for rock excav. and dry wall given are as basis for possible changes in channel lines now contemplated, but not assured.); Bardol & Roberts, 401 D. S. Morgan Bldg., *a*, $59,260; *b*, $3; *c*, $19. Buffalo Dredging Co., D. S. Morgan Bldg., *a*, $67,500; *b*, $3.85; *c*, $34. Miller & Franklin, *a*, $73,400; *b*, $7; *c*, $45. Joseph F. Stabell Co., 1127 Niagara St., *a*, $76,190; *b*, $7.20; *c*, $36.40. Pittsburg Steel Constr. Co., Pittsburg, Pa., *a*, $94,000; *b*, $7; *c*, $55.

Oneonta, N. Y.—Bridge bonds amounting to $36,000 are reported sold.

Binghamton, N. Y.—It is stated that the Lackawanna R. R. Co. (L. Bush, Ch. Engr., Hoboken, N. J.) will construct a steel bridge 900 ft. long over Chenango River here, at a cost of $150,000.

**Celina, O.*—T. A. Weis, Co. Aud., writes that contracts for constructing superstructures of bridges (bids opened Feb. 21) have been awarded as follows: Krenning Road Bridge, to C. E. Walker, of Bellefontaine, for $3,090, and Grimmic Road Bridge, to Indiana Bridge Co., of Muncie, Ind., for $3,025.

Cleveland, O.—Bids will be received Mar. 20 by the Bd. Pub. Service for furnishing material and constructing superstructure of a steel highway bridge on Detroit St., over N. Y. C. & St. L. Ry. A. R. Callow, Secy.

Jefferson, O.—Press reports state that bids will be received Mar. 11 by P. C. Renick, Co. Aud., for $200,000 Ashtabula bridge bonds.

Lebanon, O.—It is reported that bids are wanted Mar. 13 for furnishing material and constructing substructure and superstructure of Cadwallader bridge over Turtle creek, near Lebanon; also Twin Creek bridge, near Carlisle. S. A. Stilwell, Co. Aud.

**Selinsgrove, Pa.*—J. M. Shumaker, of Harrisburg, Supt. Pub. Grounds & Bldgs., writes that the contract for rebuilding the superstructure of a bridge across Penn's Creek, one mile north of here, has been awarded to Eyre Constr. Co., Arcade Bldg., Philadelphia, for $64,975 (bids opened Feb. 28).

Pottsville, Pa.—See "Electric Railways."

**Northumberland, Pa.*—The County Comrs. are stated to have awarded to the York County Bridge Co., of York, the contract for constructing a steel bridge over North Branch of Susquehanna River, for $65,125.

St. George, S. C.—The U. S. Senate has passed a bill authorizing the construction of 2 bridges over Ashley River in Charles and Dorchester Counties.

Houston, Tex.—Mayor Jackson is reported to be in favor of issuing $40,000 bonds for improving bayou bridges.

**Roanoke, Va.*—The Virginia Bridge & Iron Co., of Roanoke, is stated to have received the contract for constructing 22 bridges along the line of Deep Water Ry., of the Tidewater Ry. Co.

Spokane, Wash.—Bids will be received Apr. 4 by the Bd. Co. Comrs. for constructing steel bridge No. 22 on Marsh Road over Latah Creek. Z. Stewart, Clk.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—It is stated that the contract will soon be let for paving with creosoted wooden block or reinforced concrete with brick pavement on Twenty-first St. Bridge.

Bessemer, Ala.—Reports state that bids will be received Mar. 21 by Wm. J. Parker, City Engr., for curbing and grading certain sidewalks, requiring approximately 40,000 lin. ft. 5-in. granite curb, 160,000 cu. yds. excavation; bids will also be received on same date for laying cement sidewalks and vitrified brick alley crossings and driveways on certain streets; requiring approximately 25,000 sq. yds. cement walks, 2,000 sq. yds. vitrified brick.

Birmingham, Ala.—See "Bridges."

Mobile, Ala.—About 1¼ miles of gravel road are to be laid by the city and Mobile County jointly. J. H. Hazlehurst, Engr.

San Francisco, Cal.—See "Sewerage and Sewage Disposal."

**Jacksonville, Fla.*—Philip Priolian, City Engr., writes that J. N. C. Stockton, of Jacksonville, has secured the contract for furnishing material and paving with brick on a sand foundation 37,800 sq. yds., at $1.44⅞ per sq. yd (bids opened Feb. 13).

Bids will be received until Mar. 20 by the Bd. Pub. Wks., for grading and furnishing material and laying about 43,730 sq. yds. gravel on portions of several streets, and furnishing and placing in position 36,120 lin. ft. wood curbing. Philip Prioleau, City Engr.

South Bend, Ind.—Bids will be received by the Bd. of Pub. Wks. on Mar. 15, for brick pavement as follows: Monroe St., 9,526 sq. yds.; Hill St., 18,225 sq. yds.; Robertson St., 1,085 sq. yds.; Laurel St., 1,142 sq. yds.; Scott St., 3,029 sq. yds. and Studebaker St., 3,208 sq. yds. A. J. Hammond, City Engr.

Petitions have been filed for asphalt paving on Cushing St. and E. La Salle Ave.

Michigan City, Ind.—The City Council has passed resolutions providing for the paving of several streets, about 33,700 yd., with brick, using cement curb. Harry M. Miles, City Engr.

Shenandoah, Ia.—The City Council is stated to have passed an ordinance providing for the paving with vitrified paving brick or blocks on portions of E. Railroad, Maple, Elm, Blossom Sts. and Clarinda Ave.

Iowa City, Ia.—The paving of about 21,470 yd. on Iowa Ave. is reported under consideration, at a probable cost of $45,000.

Des Moines, Ia.—Bids will be received Mar. 14 by the Bd. Pub. Wks. for constructing brick and cement sidewalks for fiscal year 1905. W. W. Wise, Chmn.

Paducah, Ky.—S. A. Fowler, Secy. Bd. Pub. Wks., writes that there is under consideration the repaving of about 55 squares of streets with either vitrified brick or bitulithic and sidewalks of concrete. Matter not yet decided. L. A. Washington, City Engr.

**Joplin, Mo.*—A. F. Franks, of Jacksonville, Ill., is stated to have received the contract for paving Allen St., at $16,000; Church St., for $6,250, and Daugherty, Webb and Main Sts., at $7,500 each.

Helena, Mont.—Bids will be received until Mar. 20 by the City Council for paving on Main St. with either brick and asphalt, brick and bitulithic, or all brick on a 5-in. concrete foundation. Bids are to be received on the following approximate quantities: Brick and asphalt—14,200 yds. of old block removed, 1,445 sq. yds. paving gutters, 520 sq. yds. brick pavement between tracks, 12,235 sq. yds. asphalt pavement, 1,987 cu. yds. concrete, etc.; bids on bithulithic and brick—13,680 sq. yds. bitulithic, 520 sq. yds. brick, 30 cu. yds. sand for brick pavement, 1,987 cu. yds. concrete, 14,200 sq. yds. old block removed, etc.; on all brick, 14,200 sq. yds. brick pavement, 1,987 cu. yds. excavation, 1,987 cu. yds. concrete, etc. Martin Doty, City Clk.

**South Omaha, Neb.*—Herman Beal, City Engr., writes that John M. McGowan, 848 N. 28th St., has secured the contract for 8,000 ft. of artificial stone curb on Missouri Ave. (bids opened Feb. 20) at 35 cts. per lin. ft.; bids received for paving Missouri Ave. including curb opened on Feb. 20 were as follows; (*a*) Hugh Murphy, Bee Bldg., Omaha (awarded contract for paving); (*b*) Parks, Johnson & Parks, 145 N. 24th St., South Omaha; (*c*) Daniel Homan, 508 N. 24th St., So. Omaha; (*d*) Geo. Rahn, 826 N. 19th St., So. Omaha; (1) 5,000 cu. yd. excavation; (2) 19,800 cu. yd. Purington block on concrete; (3) 8,000 lin. ft. artificial stone curb:

	1.	2.	3.	Total.
a.*	$0.25	$1.90	$0.45	$42,470
b.	.19	2.01	.41	44,028
c.	.23	2.0295	.425	44,736
d.	.23	2.095	.39	45,751

Concord, N. H.—The governor has signed the bill appropriating $125,000 annually for a term of 6 years for improving the highways of the State.

New York, N. Y.—Bids will be received Mar. 9 by the Bd. Park Comrs., for furnishing and delivering a steam road roller and a road scarifier, for parks in Boro. Bronx. John J. Pallas, Chmn.

Syracuse, N. Y.—F. J. Baker submitted the lowest bid on Feb. 20 for paving Marshall St., as follows: With asphalt block, $8,970; sheet asphalt, $8,225, or brick, $8,652.

Bids will be received until Mar. 6 by the Bd. of Contract & Supply, for furnishing material and repairing asphalt pavements during the year 1905, also for 750 curb boxes. Fredk. T. Pierson, Clk.

Albany, N. Y.—All bids received Feb. 6 for repaving with asphalt blocks, about 14,500 sq. ft., on S. Pearl St., are stated to have been rejected, and, according to reports, new bids will be received.

**Brooklyn, N. Y.*—The following are the bids opened on Feb. 23 by Martin W. Littleton, Pres. Brooklyn Boro., for regulating, grading, curbing and laying sidewalks on Jerome St. from Pitkin Ave. to New Lots Road: Geo. R. Davidson, 194 Stockton St., $13,920; George & Farrell, 576 Douglass St., $12,794; Donlon Constr. Co., 82 South 3d St., $13,027; Norton & Gorman, 303 Douglass St., $13,493; McDermott & Foxton, East New York and Buffalo Aves., $13,072; Maugieri Co., 2243 1st Ave., N. Y. City, $13,759; Geo. W. Dredger, 189 Montague St., $12,366; Dan'l Douglass, 122 Logan St., $11,906 (awarded contract); M. F. Hickey, 413 10th St., $14,273; Murphy Bros., 25th Ave. and Cropsey Ave., $11,963, and Seaboard Constr. Co., 639 Gates Ave., $12,110. The detail bid of Daniel Douglass, the successful bidder, is as follows: 5,330 lin. ft. new curb, $1.10 per lin. ft.; 2,475 cu. yd. earth excav., 25 cts. per cu. yd.; 4,189 cu. yd. earth fill., 40 cts. per cu. yd., and 25,850 sq. ft. cement sidewalks, 14½ cts. per sq. ft.

New York, N.Y.—The following are the bids opened by Louis F. Haffen, Pres. Bronx Boro., on Feb. 28 for regulating, etc., Fulton Ave., from St. Paul Pl. to E. 175th St.; (*a*) D. W. Moran, (*b*) M. O'Connell, (*c*) J. H. Kerrigan:

	a.	*b*.	*c*.
3,800 yd. earth excav.	$0.90	$0.98	$0.85
7,300 " rock excav. .	2.00	1.84	1.95
3,500 " fill	.05	...	.15
6,400 ft. new curb . .	.85	.95	.85
24,000 " new flag . . .	.28	.29	.30
1,940 " bridgestone.	.65	.75	.70
100 yd. rubl masry.	.75	.01	1.50
Total . . .	$31,691	$31,652	$32,138

New York, N. Y.—The following are bids opened on Feb. 28 by Louis F. Ha Pres. Bronx Boro., for regulating, etc., W chester Ave. to Dater St.: G. Eickwort, 252; W. E. Welch, $18,102; J. J. McQ $18,022. The detail bid of G. Eickwort, lowest bidder, is as follows: 3,950 cu. earth excav., $1.40 per cu. yd.; 4,100 cu. rock excav., $1.40; 900 cu. yd. fill, 50 2,150 lin. ft. new curb, 90 cts.; 8,800 s new flag, 35 cts.; 312 sq. ft. new bridges 60 cts., and 165 cu. yd. dry rubble m ry, $2.

Cleveland, O.—The following are the opened by the Bd. of Pub. Service on Fe for paving—*a*, Lorain St. with con Medina stone; *b*, Bellflower Ave. with adam; *c*, Bank St. with dressed block M stone; *d*, Bway. with dressed block M stone: R. B. Burnett, *a*, $7,847; *c*, $7, *d*, $13,546. Cleveland Trinidad Paving *a*, $8,117; *b*, $19,149; *c*, $8,536; *d*, $14 Standard Paving Co., *a*, $8,128; *c*, $8, *d*, $14,492. Northern Ohio Paving & C Co., *a*, $8,559; *b*, $21,687; *c*, $8,749; *d*, 256.

Jerry City, O.—Bids will be received Mar. 23 by J. A. Dennis, Clk. Bloom T ship, P. O. Jerry City, for quarrying, c ing and delivering stone on portions of se roads, in all approximately 20,305 cu. yd

Cincinnati, O.—Bids will be received 20 by the Bd. Pub. Service, for furnis material and improving by grading, cur and paving with granite block a portio Smith St., and with brick a portion of ner St. Geo. F. Holmes, Clk.

*The Bd. of Pub. Service is stated to awarded on Feb. 24 the contract for pa with asphalt and granite on a portio Clark St., to Barber Asphalt Paving Co., $15,765.

*Thos. Evans, of Ida St., has secured contract for furnishing material and gra and paving a portion of Marmet St. granite, about 2,000 sq. yd., for $8,575.

Lakewood, O.—Bids are wanted Mar for $4,800 Lake Ave. improvement b Henry J. Sensel, Village Clk.

Cincinnati, O.—City Engr. Breen is st to have estimated the cost of paving port of several streets as follows: 5th, with phalt, $27,498; 2d, with granite, $118, Prospect Pl., bitulithic, $23,556; Pike with bitulithic, $8,504, and Borden St., brick, $5,047.

Bids will be received Mar. 24 by the Pub. Service for furnishing material and proving by grading, curbing, flagging and ing gutters and macadamizing roadway portion of Irwin St.; bids will also be ceived on same date for improving by g ing, curbing, flagging gutters, boulde roadway and constructing necessary dr and retaining walls, on a portion of M St. Geo. F. Holmes, Clk.

Bids will be received Mar. 25 by the Co. Comrs. for improving Lees Creek R in Harrison Township. Eugene L. Lewis, Aud.

**Toledo, O.*—The following contracts stated to have been awarded on Feb. 21 repaving a portion of Warren St.: Russe Jennison, for $4,867; paving with Metro tan brick on portion Monroe St., Garr Bros., Valentine Bldg., $2,790.

East Palestine, O.—This village has in templation the paving of Main St. with b about 12,000 sq. yd.

**Brooklyn, N.Y.*—The following are the bids opened on Feb. 23 by Martin W. Little Pres. Brooklyn Boro., for regulating and repaving certain streets with asphalt on a conc foundation; (*a*) Cranford Co., 52 9th St., Brooklyn; (*b*) Brooklyn Alcatraz Asphalt Co., St. and Gowanus Canal, Brooklyn; (*c*) Barber Asphalt Paving Co., 114 Liberty St., York City; (*d*) Eastern Bermudez Asphalt Paving Co., 26 Court St., Brooklyn; (*e*) Uv Asphalt Paving Co., 1 Broadway, New York City:

Atlantic Ave., from Nostrand to Troy Ave.

	a.	*b*.	*c*.	*d*.	*
21,780 sq. yd. asphalt pav't	$1.07	$1.05	$1.13	$1.05	$
60 " adjacent pav't	.35	.30	.19	.35	
3,530 cu. yd. concrete	4.75	4.90	3.74	6.00	
6,140 lin. ft. new curb	.85	.85	.84	1.60	
1,160 " old curb, reset	.35	.30	.30	1.00	
76 noiseless covers and heads	15.00	15.00	15.00	15.00	1
57,880 sq. ft. cement sidewalks	.15	.15	.14	.20	
17 sewer basins reset	50.00	45.00	35.00	50.00	5
Total	$56,390	$56,338	$53,169	$68,620	$52

Atlantic Ave., from Dewey Pl. to East New York Ave.

	b.	**c*.	*e*.	
28,950 sq. yd. asphalt pav't	$1.05	$1.08	$0.99	$
240 " adjacent pav't	.30	.19	.35	
4,610 cu. yd. concrete	4.90	4.16	5.25	
6,590 lin. ft. new curb	.85	.84	.85	
2,450 " old curb, reset	.30	.30	.35	
101 noiseless covers and heads..........	15.00	15.00	15.00	1
69,480 sq. ft. cement sidewalks	.15	.14½	.14	
24 sewer basins, to be reset	45.00	35.00	50.00	5
Total	$72,412	$69,189	$71,848	$72

Atlantic Ave., from Troy Ave to Dewey Pl.

	e.	**c*.	*a*.	
27,560 sq. yd. asphalt pav't	$0.95	$1.10	$1.07	$
170 " adjacent pav't	.35	.19	.35	
4,440 cu. yd. concrete	5.10	3.97	4.75	
6,240 lin. ft. new curb	.80	.84	.85	
2,980 " old curb, reset	.35	.30	.35	
103 noiseless covers and heads..........	15.00	15.00	15.00	1
72,380 sq. ft. cement sidewalks	.14	.14¼	.15	
18 sewer basins reset	50.00	35.00	50.00	4.
Total	$67,499	$66,600	$70,288	$70

**Brooklyn, N. Y.*—The following are the bids opened on Feb. 23 by Martin W. Little Pres. Brooklyn Boro., for repairing and maintaining asphalt pavement in various streets Brooklyn Boro.; (*a*) Cranford Co., 52 9th St., Brooklyn; (*b*) Barber Asphalt Paving 114 Liberty St. (awarded contract); (*c*) Uvalde Asphalt Paving Co., 1 Bway, N. Y. City:

	a.	**b*.	
3,000 sq. yd. asphalt pavement, including binder course, in plumbers' cuts	$2.00	$1.24	$
55,000 cu. ft. asphalt wearing surface, delivered and laid in place of old surface destroyed or removed	.77	.67	
500 cu. yd. Portland cement concrete..........................	6.00	4.83	
11,000 cu. ft. binder, delivered and laid	.35	.25	
12,000 " asphalt wearing surface, delivered and laid in repairing surface defects, by burner method..................	.90	.67	
Total	$66,000	$53,775	$60,

**Items marked thus give the names of parties awarded contracts.*

eland, O.—The following are the bids opened on Feb. 21 by the Bd. of Pub. Service sed block Medina stone paving; (*a*) R. P. Burnett, (*b*) Cleveland Trinidad Paving Co., hern Ohio Paving & Constr. Co., (*d*) John F. Brennan, (*e*) Standard Paving Co.:

Marquette St., from Willson Ave. to L. S. & M. S. R. R.

	a.	*b.*	*c.*	*d.*	*e.*
u. yd. excavation or embankment	$0.27	$0.25	$0.17	$0.30	$0.30
q. ft. common Medina pav't laid	.26	.27	.10	.28	.26
" common stone pav't relaid	.09	.10	.08	.09	.07
" dressed Medina block laid	.321	.33⅓	.34¼	.33⅔	.34
" dressed Medina block relaid	.09	.10	.08	.09	.07
" concrete foundation laid	.06⅘	.07¼	.07	.07½	.07¼
" Brick pavement laid	.16	.15	.16	.14¾	.15
" brick pavement relaid	.08	.05	.10	.07	.07
in. ft. Medina curb set	.60	.65	.70	.65	.60
" curbstone reset	.09	.10	.05	.08	.10
sq. ft. Medina crosswalk laid	.44	.45	.55	.48	.30
in. ft. crosswalk relaid	.06	.10	.08	.08	.08
new catch basins, each	37.00	35.00	40.00	38.50	40.00
lin. ft. 12-in. catch basin pipe	.50	.80	.90	.80	1.00
sq. ft. new flag furnished and laid	.14	.16	.15	.15	.15
Total	$30,538	$31,858	$32,149	$32,477	$32,319

Detroit St., from Pearl to Waverly Ave.

	e.	*c.*	*d.*	*b.*
cu. yd. excavation or embankment	$0.30	$0.05	$0.30	$0.25
sq. ft. common Medina pav't laid	.28	.10	.28	.26
" common stone pav't relaid	.07	.08	.08	.10
" dressed Medina block laid	.34	.34¼	.33½	.33⅓
" dressed Medina block relaid	.08	.08	.08	.10
" concrete foundation laid	.07½	.07	.07½	.07¼
0 " brick pavement laid	.14½	.16	.14¾	.15
0 " brick pavement relaid	.02	.10	.08	.05
0 lin. ft. 5-in. Medina curb set	.65	.68	.65	.65
0 " 4-in. Medina curb set	.65	.50	.55	.55
" curbstone reset	.10	.05	.08	.10
0 sq. ft. Medina crosswalk laid	.30	.50	.48	.45
0 lin. ft. crosswalk relaid	.08	.08	.08	.10
8 new catch basins, each	40.00	40.00	38.50	35.00
0 old catch basin covers reset	3.00	2.00	2.50	6.00
0 lin. ft. 12-in. catch basin pipe	.75	.90	.80	.80
0 old catch basins cleaned	1.50	1.50	1.50	2.00
3 new manholes built	40.00	40.00	40.00	40.00
0 sq. ft. 3-in. flag, furnished and laid	.15	.16	.15	.16
0 " flag relaid	.02	.04	.02	.04
0 lin. ft. old 12-in. c. b. pipe relaid	.20	.30	.40	.50
0 " 4-in. Medina curb reset	.20	.18	.20	.14
0 sq. ft. old pavg stone allowed for	.01	.00¼	.001	.00⅛
0 lin. ft. old curb stone allowed for	.04	.00½	.01	.01
Total	$85,565	$86,812	$57,492	$86,059

dville, Pa.—The following are the bids d on Feb. 15 for paving Park St. with c or asphalt block:

ck pavement complete, including storm s, 6-in. curb and 5-in. concrete founda- John Swan, Jr., Allegheny, $28,435; McGuigan, Meadville, $26,933; G. Bur- Jamestown, N. Y., $32,297; Harris & y, Youngstown, O., $29,651; John & M. cCormick, Erie, $32,683; Burt Smith, en, O., $31,884; Fred. Robinson, Mead- $29,035; L. C. Klosterman, Pittsburg, 18; Jas. Ferry & Son, Crafton, $28,743. halt block, 3 in. thick on 7-in. slag ation, combined (cement) curb and gut- including all storm sewers: Jas Ferry & Crafton, $35,965; Fred. Robinson, Mead- $34,349; Burt Smith, Warren, O., $32,- Thos. McGuigan, Meadville, $32,719, John Swan, Jr., Allegheny, $32,466.

irton, Pa.—Bids will be received Mar. 20 M. Roberts, Boro. Clk., for improving a on of 3d St. by paving with brick and ructing drainage system; requiring ximately 5,700 cu. yds. excav., 9,400 sq. brick, 5,000 lin. ft. stone curbing, dressed, in. ft. stone curbing, rough, 300 lin. ft. . sewer connection, etc. C. D. Supplee, . Boro Bldg., Clairton.

ncaster, Pa.—Bids will be received Mar. y the Pa. State Highway Dept., at Har- rg, for constructing 5,280 ft. road in Earl nship; 2,640 ft. road in Rapho Town- and 3,020 ft. road in Penn Township, n Lancaster Co.

iladelphia, Pa.—See "Power Plants, Gas Electricity."

nsdale, Pa.—See "Power Plants, Gas and tricity."

legheny, Pa.—See "Sewage and Sewerage osal."

coma, Wash.—Contracts will probably be ome time in March or April for 10 miles sphalt paving. Frank L. Davis, City r.

attle, Wash.—The following are the bids ned on Feb. 18 by the Bd. of Pub. Wks., grading Wallingford Ave.; (*a*) A. C. rig, Seattle; (*b*) Thorsvig & Lindland, ttle:

	a.	*b.*
d estimate	$2,000	$2,000
46.6 acres clearing, etc.	120.00	80.00
000 cu. yd. earthwork	.30	.25
100 " solid rock	1.00	1.00
33 M. ft. bulkhead lumber	15.00	14.00
,800 lbs. iron for bulkhead.	.06	.04
300 lin. ft. railing	.10	.08
90 " 12-in. pipe clvrt	.75	1.00
110 " 18-in. " "	1.50	1.00
222 " 24-in. " "	2.25	3.00
2 M. ft. box drains	.20	.30
Total	$68,337	$56,652

he Bd. of Pub. Wks. is stated to have ned the following bids on Feb. 18 for re- ding a portion of 9th St.: A. Normile, 379; A. R. Gibson, $9,378; N. McKinnon, 133; Frank & Brandon, $8,852; A. C. rig, $8,472; Isaac Carlson, $8,000; Josiah es, $7,219.

ellingham, Wash.—F. B. Groves, City nptroller, writes that about $40,000 to ,000 will be expended for asphalt or vitri- l brick paving. Geo. M. Gerhard, City gr.

atertown, Wis.—It is reported that bids l be received until Mar. 11 for improving eral streets. Frank S. Weber, City Clk.

OWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Greenville, Ala.—The City Council has nted the C. C. Henderson Electric Light . a franchise for an electric light plant. e plant will be in operation in 4 months.

Dothen, Ala.—This city is contemplating installing a 250-kw. revolving field alternator, a 375-h.p. engine, and changing the circuits (except power) from D. C. to A. C. and installing 50 series enclosed arcs. W. E. Culver, Supt.

Paragould, Ark.—The Crystal Ice Co., owners of the electric light plant, propose installing a 250-h.p. boiler. M. F. Van Sickle, Mgr.

Little Rock, Ark.—This city is reported to be contemplating installing a 350-h.p. boiler and a 350-h.p. engine at the electric light plant. John W. Bleidt, Supt.

Santa Monica, Cal.—It is reported that bids will be received until Mar. 27, by the Bd. of Trus. for a gas franchise.

Richmond, Cal.—J. B. McKenzie is stated to have petitioned the Bd. of Superv. for a franchise for a gas plant.

Lakeport, Cal.—It is reported that Jas. K. Burch has applied for a franchise to erect, maintain, suspend wires and poles on highways, streets and alley of said town for the purpose of transmitting light, power and heat, and bids for said franchise will be received Apr. 3 by H. V. Keeling, Clk. City Trus.

Cedarville, Cal.—H. Hawkins is reported interested in the construction of an electric light plant.

Empire, Colo.—W. P. Clough, of Empire, is reported interested in the Clear Creek County Power & Irrigation Co., which proposes constructing a water power plant for the generation of electricity to supply the mines of the Clear Creek District, and also for irrigation purposes.

Silverton, Colo.—It is proposed to install at the municipal electric light plant a 110-kw. unit and new switchboard and remodel lines to 3 phase. H. S. Sherman, Mgr.

Glastonbury, Conn.—J. S. Williams, of Glastonbury, Pres. Glastonbury Power Co., writes that engineers are now at work and specifications are not yet completed for work in connection with the construction of its power house and dam. No contract let as yet.

Wallingford, Conn.—It is proposed to develop water power of about 200 kw. for day service at the municipal electric-light plant. A. L. Pierce, Mgr.

Aguilar, Colo.—It is reported that a company is about to be formed by A. R. Lindsey, Morris Petti and others, to construct an electric light plant, at a cost of about $10,000.

Tifton, Ga.—The Tifton Ice & Power Co. will install a new engine and dynamo. S. M. Roberts, Mgr.

Washington, Ga.—It is proposed to install at the municipal electric light plant, a 150-kw. A. C. generator. Thos. Ludlow, Supt.

Morton, Ill.—Beyer Bros., owners of the electric light plant, contemplate increasing power circuit to 150-kw. and put in one 200-h.p. engine.

Moweaqua, Ill.—The Moweaqua Electric Co. (W. N. McKee, Mgr.) proposes installing a steam heating plant (exhaust).

Decatur, Ill.—A new gas and electric-light company is reported to have been formed here by W. L. Shellabarger, Jas. J. Finn, and others, with a capital of $50,000. The company will apply at once for a franchise.

Kirkwood, Ill.—The Kirkwood Electric Co. (J. F. White, Mgr.) will add a steam-heating and pumping plant for city, and extend lighting service to two neighboring towns.

East St. Louis, Ill.—Mayor Cook has appointed C. B. Goedde, Jacob Gohn and L. Smith a committee to visit other cities to ascertain the cost of electric lighting and of municipal ownership of electric plants. W. J. Crocker, City Engr.

Vermont, Ill.—The city will soon purchase a dynamo for the electric-light plant. E. L. Durell, Mgr.

Lebanon, Ill.—It is proposed to install at the city light plant a dynamo, engine and new smoke stack.

Zion City, Ill.—The Zion Bldg. & Mfg. Assoc. contemplates installing a 500-h.-p. engine directed-connected to a 300-kw., a. c., 3-phase, 60-cycle (General Electric Co.); one 100-kw., d. c., to be part of motor generator set, d. c., 250 volts; one 100-kw., a. c., 3-phase, 60-cycle G. E. machine; a switchboard of 11 panels; two 250-h.-p. boilers of "Cahall" type and a series a. c. street lighting system. Burton C. Dennis, Mgr.

Elgin, Ill.—The Elgin Hydraulic Co. writes that nothing definite has yet been done toward constructing a power plant at Elgin.

Odon, Ind.—The Odon Light & Power Co. (C. N. McNeely, Mgr.) proposes constructing a new power house with new engine, boilers and dynamos; also water works.

Terre Haute, Ind.—The McCulloch Co., of St. Louis, Mo., is stated to have been selected to prepare plans and estimates for a municipal electric-light plant.

Ridgeville, Ind.—The Ridgeville Electric Light, Heat, Power & Water Co. is reported incorporated to construct a light, heat and water plant. Jos. Lay, Pres.

Muncie, Ind.—W. F. Warren, Supt. City Electric light plant, writes that it is proposed to construct a new central lighting plant at once. Will use gas or oil engines and storage batteries; plant to cost $120,000.

Manson, Ia.—The Manson Electric Light Co. (Wm. Folkerts, Supt.) is reported to be considering the purchase of a new engine.

Webster City, Ia.—E. L. Wortham and O. H. Brown, of Des Moines, are reported to have petitioned for a franchise for a gas plant.

Decorah, Ia.—The Decorah Electric Light Co. proposes developing a water power and transmission line to operate this plant, and one at Waukon, in all 18 miles of line. There will be required beside a dam, two 200 to 250-h.p. wheels, two 128-kw., 6,600-volt, 3-phase, 60-cycle generators, about 250 kw. in transformers and the usual items for such an equipment. W. H. Burtis, Pres.

Northwood, Ia.—The Northwood Electric Light Plant (L. F. Madson, owner) contemplates installing an engine, 2 generators and switchboard apparatus.

Corning, Ia.—C. K. Munns, owner of the Corning Electric Co., expects to overhaul the entire outside construction the coming spring.

Creston, Ia.—Mayor J. C. Sullivan is reported interested in the formation of a company to install an electric light plant.

Jewell, Kan.—A. G. Blackenship is reported interested in the construction of an electric-light plant.

Leavenworth, Kan.—The United Gas & Electric Co. contemplates purchasing 2 new boilers, 72x18, horizontal. M. E. Springer, Mgr.

The Council is stated to have passed an ordinance granting Thos. J. Loftus a franchise for a heating plant.

**Coffeyville, Kan.*—Contracts for electrical equipment, bids opened by City Council on Feb. 8, have been awarded as follows (W. K. Palmer, Consulting Engr., 718 Dwight Bldg., Kansas City, Mo.): For two 200-kw. Westinghouse generators with exciters, to Hodge-Walsh Co., Kansas City, Mo., $4,800; two simple Hamilton-Corliss engines, to Hooven-Owens, Rentschler Co., St. Louis, Mo., $5,500; 4 tubular boilers and stacks for boilers, to C. A. Burton Co., Kansas City, Mo., $3,875; piping, valve covering, etc., to Arthur McKinley Co., Kansas City, Mo., $1,369; switchboard (Westinghouse), to Hodge-Walsh Co., Kansas City, Mo., $994; belt, to Geo. W. Webb & Co., Kansas City, Mo., $593, and heater, to Walter L. Flower & Co., St. Louis, Mo., $455.

Carlisle, Ky.—The citizens' electric light plant is reported to have been destroyed by fire on Feb. 18.

Natchitoches, La.—The Natchitoches Electric Light Co. contemplates purchasing a new engine and dynamo. J. R. Carroll, Supt.

Lake Charles, La.—S. O. Shattuck, City Clk., writes in regard to the construction of a municipal electric light plant for Lake Charles that Ruebel, Schwettman & Wells, of St. Louis, Mo., have completed plans and specifications for a plant, to cost about $70,000. The matter is now in the hands of the City Attorney, who will probably get the matter in shape very shortly.

Bar Harbor, Me.—Press reports state that New York and Boston capitalists have purchased the stock of the Bar Harbor & Union River Water Power Co., and will construct a dam 60 ft. high on Union River near Ellsworth.

Saulte Ste. Marie, Mich.—It is reported that about $1,000,000 will be expended by the Michigan Lake Superior Power Co. for improvements.

Hopkins Station, Mich.—W. F. Nicoli, of Hopkins Station, is reported interested in the construction of an electric-light plant.

Romeo, Mich.—It is proposed to install a 1,500 light alt. and 45 alt. arc lamps at the village electric-light plant. May possibly purchase a 60-h.-p. engine. B. N. Seaman, Secy. Light Comn.

Zeeland, Mich.—It is proposed to install at the village electric-light plant some time this spring or summer a 25-kw., 235-volt direct-connected unit.

Dowagiac, Mich.—The citizens will in the spring vote on improvements to the electric-light plant, to include the rebuilding of the pole line and rewiring the system, which will call for about 20 miles of No. 6 W. P. wire; a regulator at the station with about 75-kw. capacity; installing about 150 Inc. series lamps, etc. D. E. Connine, Supt.

St. Clair, Mich.—This city contemplates installing a new boiler and pumps at the electric-light and water-works plant. Walter Ash, Ch. Electrician.

Shelby, Mich.—It is proposed to install at the municipal electric plant, new engines, an A. C. generator and meter system. H. L. Andrus, Supt.

Kalamazoo, Mich.—The Kalamazoo Gas Co. is stated to have decided to expend about $75,000 this year in improvements, including a gas holder and some large feed mains.

Alpena, Mich.—Bids will be received by R. J. Crable, City Recorder, on March 23 for the construction of water works and an electric light plant, as advertised in The Engineering Record.

Keystone, Minn.—The Keystone Lumber, Power & Development Co. is reported organized for the purpose of utilizing water power and furnishing electric-light to Keystone. C. J. Patton, of Keystone, is reported interested.

Stillwater, Minn.—The plant of the Stillwater Lighting Co., at South Stillwater, is reported to have been damaged by fire on Feb. 21, to the extent of about $5,000.

Owatonna, Minn.—The Owatonna Gas, Electric & Htg. Co. (E. G. Porter, Mgr.) proposes installing a gas plant.

Thief River Falls, Minn.—It is proposed to install at the municipal electric light plant a 100-kw. D. C. generator and 3,500 ft. 500,000 C. M. base standard cable for feeder.

Graceville, Minn.—It is proposed to enlarge the municipal electric light plant in the spring by installing one D. C. generator. P. F. Daly, Supt.

Wiggins, Miss.—The Wiggins Electric Light Co., of Wiggins, is reported incorporated, with a capital of $10,000. W. H. Rowan is one of the incorporators.

Greenville, Miss.—The Greenville Light & Power Co. (L. B. Bradley, Receiver) contemplates the complete re-equipment of its station.

Port Gibson, Miss.—This city contemplates installing at the electric-light plant one 125-h.-p. return tubular boiler and stack, 48 in. x 40 ft., on brick base. C. E. Mason, City Clk.

Jefferson City, Mo.—The Jefferson City Light, Heat & Power Co. (H. H. Humphrey, Mgr.) will, it is reported, add to the present service a power plant motor service and lighting service for arc and incandescents.

Lamar, Mo.—The Lamar Light & Water Co. (W. O. Settle, Supt.) proposes installing an engine, boiler and alternator, in the spring.

Sedalia, Mo.—The Sedalia Water & Light Co. (L. P. Andrews, Mgr.) proposes combining its three electric plants in one and constructing a new central station.

Ste. Genevieve, Mo.—The Ste. Genevieve Light & Ice Co. (E. L. Coleman, Mgr.) proposes installing water works.

Alma, Neb.—The citizens are reported to have voted Feb. 21 to issue bonds for water works and an electric light plant.

Plattsmouth, Neb.—The Nebraska Lighting Co. is stated to have decided to expend $25,000 in rebuilding the gas plant. Extensive improvements are also to be made to the electric plant.

Fremont, Neb.—It is proposed to install at the municipal electric light plant a series incandescent street light system, at a cost of about $3,000. J. H. Mathews, Supt.

Blair, Neb.—The Blair Electric Light & Power Co. (E. V. Capps, Mgr.) proposes installing a new boiler, D. C. generator and day circuit.

Monroe, N. H.—The House has passed a bill incorporating the Monroe Water Power Co., which proposes constructing dams across Connecticut River and furnishing electricity in New Hampshire and Vermont. A. S. Batchellor, of Littleton, N. H.; Chas. H. Hosford, of Monroe, and Geo. Van Dyke, Boston, Mass., are among the incorporators.

Dover, N. J.—Bids will be received Mar. 28 at the office of U. S. Powder Depot, for erecting in brick and steel one wheel and dynamo-house, a building for general shops, 6 store-houses and a magazine building. Address Commaning Officer.

**Trenton, N. J.*—The Common Council is stated to have on Feb. 22 awarded the contract for supplying the city with 500 Welsbach gas lamps at $29.75 per lamp per yr., for 3 yrs., to the public Service Corporation, and the contract for supplying 100 naphtha lamps at $26.40; 4-10 of the contract to be given to the American Street Lighting Co. for one year.

Perth Amboy, N. J.—The Citizens' Light, Heat & Power Co. is reported formed by J. K. Sheery, C. C. Hommann, an attorney, and others, with a capital of $125,000, to construct an electric light plant.

East Creek, N. Y.—The East Creek Electric Light & Power Co. (J. D. Cairns, Mgr., St. Johnsville) is reported to have in contemplation another water-power plant 3½ miles further up same stream.

Items marked thus give the names of parties awarded contracts.

Middletown, N. Y.—The Orange County Lighting Co. (W. J. Max, Supt.) contemplates installing some new machinery.

Geneseo, N. Y.—The Geneseo Gas, Light Co. (Alex. Wyness, Jr., Mgr.) contemplates building 2 miles of line, this spring.

Warrensburgh, N. Y.—The Warrensburgh Electric Light Works (John G. Smith, owner) contemplates installing a new turbine.

Jamesville, N. Y.—The Thomas Millen Cement Co., of Jamesville, is reported to have in contemplation the construction of an electric plant, to be used for furnishing light and power to its works and also furnishing lighting and power for all the surrounding villages.

Niagara Falls, N. Y.—The Niagara Falls Electrical Transmission Co. is reported formed, with a capital of $100,000, by Harry Highland and Frank A. Dudley, of Niagara Falls; Fred. Nichols, of Toronto, Ont., and others, to sell and transmit gas and electricity all over Western New York as far as Rochester.

Buffalo, N. Y.—The Bd. of Aldermen has received from Acting Comr. Morse, of the Dept. of Pub. Wks., a preliminary estimate of the cost of a municipal electric light plant. He figures the total cost to build it on city lands, at the foot of Jersey St., would be $1,792,000. Each arc light would cost $72.20 per yr., and each incandescent lamp, 6 cts. per kw.

Canastota, N. Y.—The Electric Light Com. (E. Saltsman, Chmn.) is stated to have submitted its report on the construction of a municipal electric-light plant; it estimates the cost of a plant, with a capacity of 50-arc lights and 6,000 incandescent lights, at from $30,000 to $35,000.

Pittsford, N. Y.—The Pittsford Light & Heat Co., of Pittsford, is reported incorporated by Saml. Hutchinson, John Steve and B. N. Wiltsie, of Pittsford.

Jamestown, N. Y.—It is proposed to install at the city electric-light plant, one 200-kw. Turbo outfit and 50 street lights. C. G. Sundquist, Mgr., 136 Steele St.

Brooklyn, N. Y.—The Dept. of Yards and Docks, Navy Dept., Washington, D. C., is reported to be getting ready to take first steps in the consolidation of power plants at the Navy Yard in Brooklyn. The changes will involve the moving of machinery, purchasing new machinery, and laying pipes for heating purposes; probable cost of work contemplated reported to be $450,000. It is also proposed to consolidate the plants in other navy yards, the work to cost as follows: Portsmouth, N. H.; Boston, Mass., and Norfolk, Va., each $250,000; and League Island, Pa., $75,000.

**New York, N. Y.*—The following are the bids opened on Feb. 20 by C. B. J. Snyder, Supt. School Bldgs., for electric equipment of schools in Manhattan Boro.—*a*, De Witt Clinton High School; *b*, School No. 83: Reis & O'Donovan, *a*, $43,210; *b*, $7,770. Fred. Pearce, *a*, $43,104. Commercial Constr. Co., *a*, $38,817. W. M. Sheehan & Co., 136 Liberty St., *a*, $37,658 (awarded contract); *b*, $6,737 (awarded contract). Johnston Livingston, Jr., & Co., *a*, $42,983. Peet, McAnerney & Powers, *a*, $38,665; T. Fred. Jackson, *b*, $7,700. Henrette & Bentley, *b*, $8,332.

Bids will be received Mar. 15 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for furnishing, operating and maintaining electric lamps for lighting streets, public buildings and parks; also for furnishing gas and other illuminating material for, and lighting, extinguishing, cleaning, repairing and maintaining lamps and supplying gas, etc., for new lamps when required, making certain repairs to lamp posts, and for furnishing burners and appliances of improved system of lighting on streets, public buildings, avenues, piers, parks and public places for term of 9 months and 16 days from Mar. 16 to Dec. 31, 1905, in Boro. Manhattan, Bronx, Brooklyn, Queens and Richmond.

The Bd. of Estimate of Feb. 24 appropriated $600,000 to purchase a site and to begin the construction of the proposed municipal electric light plant.

Tarboro, N. C.—It is proposed to install at the municipal electric light plant a 150-h.p. boiler. C. A. Johnson, Pres.

Asheville, N. C.—B. M. Lee, City Engr., writes that the Legislature has granted this city permission to borrow money for an electric light plant, but it has not yet been decided whether to do the work or not.

Marion, O.—The Columbus, Delaware & Marion Ry. Co. (Geo. Whysall, Gen. Mgr., Delaware, O.), owners of the electric light plant, propose installing new power house equipment and will rebuild pole line and change arc system.

Massillon, O.—Press reports state that it is proposed to bond the city for $500,000 to be used for the construction of water works, an electric light plant and city hall.

Provo, Utah.—O. S. Buell, of Denver, Colo., and W. B. Searle, of Provo, have made application in State Engr's office to appropriate 2,500 cu. ft. per second of the water in Green River, to be used for the development of power; it is estimated that the contemplated works will cost $250,000.

Loveland, O.—The City Council is stated to have granted H. C. Hubbell, of Toledo, a franchise to construct water works and electric light plant at Loveland.

Dayton, O.—Bids will be received Mar. 22 by the Bd. Trus. of Dayton State Hospital for furnishing and erecting a battery of water-tube boilers with automatic stokers; coal conveying and ash-handling machinery; piping of power plant and tunnel, and pipe covering. A. F. Shepherd, M. D., Secy.

Jamestown, O.—The Jamestown Electric Light Co. will install a new A. C. incandescent dynamo. S. A. Brown, Mgr.

Reading, O.—The Council is preparing to call an election to vote on issuing $25,000 for improvements to the electric-light plant. C. V. Dils, Secy.

Carrollton, O.—The Carrollton Electrical Co. will in the spring add a new engine, dynamo and boiler. E. L. Swann, Mgr.

Dallas, Ore.—The Dallas Electric Light Co. (J. G. Van Orsdal, Mgr.) proposes installing a 200-h.p. engine, a 125-h.p. boiler and line extension.

Homestead, Pa.—A stock company is reported formed by Geo. S. Debolt and W. S. B. Hays, to construct an electric light plant.

Williamsport, Pa.—The Citizens' Electric Co. contemplates installing a 150-kw. water-power plant and a 300-kw. fuel-oil plant as soon as the weather permits. J. Fisher, Mgr.

**Pittsburg, Pa.*—The National Tube Co., of McKeesport, is stated to have secured the contract for pipe for the U. S. Natural Gas Co., for about $800,000. Organized under the laws of West Virginia the U. S. Natural Gas Co. contemplates the absorption of the Triple State and Kanawha Gas Companies of West Virginia, the laying of over 150 miles of lines and the control of nearly 200,000 acres of gas land in West Virginia and Kentucky. Chas. Miller, of Franklin, is a director of the company.

Philadelphia, Pa.—Bids will be received Mar. 7 at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing at the navy yard, League Island, a quantity of wire, conduit and fittings, electrical supplies and vitrified paving blocks. H. T. B. Harris, Paymaster Gen., U. S. N., Washington, D. C.

Lansdale, Pa.—The citizens are reported to have voted Feb. 21 to issue $25,000 for improving the electric light plant and for paving.

Fairchance, Pa.—The Boro. Council is stated to have granted the West Penn. Lighting Co. (W. E. Moore, Gen. Supt., Connelsville) a franchise to extend its lines on all the streets of the borough.

Shippensburg, Pa.—The Shippensburg Gas & Electric Co. (C. W. Harman, Mgr.) contemplates improvements to its gas plant, including a new holder and extensions of mains.

Dell Rapids, S. D.—There is some talk of installing an electric light or gas plant.

Lead, S. D.—The Belt Light & Power Co. (J. B. Baker) contemplates installing three 500-kw. units, with boilers, etc., 20 miles new power lines, 1,000 h.p. in motors, etc.

Dickson, Tenn.—Wm. McDonough, of the Dickson Machinery Repair Co., is reported interested in the construction of an electric light plant.

Rockwood, Tenn.—It is proposed to install at the municipal plant a 180-h.p. engine. S. P. Swanson, Supt.

Knoxville, Tenn.—Local press reports state that the Knoxville Power Co. will probably during the coming spring, commence the construction of its power plant.

Memphis, Tenn.—The Council on Feb. 24 passed an ordinance granting the Merchants' Light & Power Co. a 30-yr. franchise.

Brownsville, Tenn.—The Burt-Smith Co., owners of the electric light plant, contemplate installing during the year a 150-kw. dynamo and other improvements. Burt Smith, Pres.

Plano, Tex.—The J. T. Stark Grain Co. (W. F. Muegge, Supt.) proposes installing a new engine.

Ft. Worth, Tex.—Press reports state that E. G. Bruckman, Vice-Pres. of the firm of G. H. Walbridge & Co., 32 B'way, New York, N. Y., is at Ft. Worth in the interest of establishing in Ft. Worth an electric light and power plant.

Salt Lake City, Utah.—Sam'l Newhouse has petitioned City Council for a franchise for an electric light plant.

Lexington, Va.—The Lexington Light & Power Co. contemplates installing a 250-h.-p. turbine, one 180-kw. alternator, and a 250-h.-p. steam plant. D. C. Humphreys, Vice-Pres., Lexington.

Winchester, Va.—Dr. H. H. McGuire is Chmn. of Com. which has under consideration the question of constructing an electric-light plant, at a cost of $25,000.

Colonial Beach, Va.—Warren S. P. Combs, Pres. Colonial Beach Electric Light & Power Co., writes that it is proposed to construct an electric light plant, ice plant, telephone system and steam laundry, at a cost of $25,000.

Seattle, Wash.—It is proposed to expend about $250,000 for extensions to the electric light system for domestic light and for power purposes. The work will be done under city superintendence and not let out by contract. Engineer, J. D. Ross, 402 Yesler Way.

Snohomish, Wash.—The Snohomish Electric Light & Water Power Co. (O. Lewis, Mgr.) contemplates installing a 300-h.p. engine and line extensions.

Kingwood, W. Va.—It is proposed to purchase a new dynamo and install new wiring for the town electric-light plant. J. H. Kramer, Chief Electrician.

Kaukauna, Wis.—The Kaukauna Electric Light Co. (A. R. Coates, Mgr., Kaukauna) contemplates adding to its water wheel capacity and installing a d. c. power circuit furnishing 100 h.p.

Campbellsport, Wis.—The Dundee Water Power & Electric Light Co. proposes installing a steam plant. L. Arimard, Mgr., Campbellsport.

Owen Sound, Ont.—It is stated that bids are wanted Mar. 17 for $15,000 gas plant improvement bonds and $10,000 electric light plant improvement bonds. A. J. Spencer, Town Treas.

Bracebridge, Ont.—This city contemplates duplicating its present machinery at the municipal electric light plant, at an early date. Alex. C. Salman, Secy.-Treas. of Council.

Fenelon Falls, Ont.—The Bd. of Water, Light & Power Comrs. (Dr. D. Gouldy, Chmn.) proposes installing an arc light plant of 50 lights.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Modesto, Cal.—It is reported that H. B. Kinney has applied for an electric railway franchise, and bids for said franchise will be received Mar. 15 by W. J. Martin, Clk. Bd. Supervs.

Los Angeles, Cal.—Surveyors are locating the right of way for the Los Angeles-Pacific R. R. Company's new electric railway from the Soldiers' Home to Santa Monica via Santa Monica Canyon.

H. J. Lelande, City Clk., writes that the Los Angeles Ry. Co. on Feb. 6 secured a franchise for a street railway on 6th St.

It is reported that bids will be received Mar. 21 by the Bd. Supervs. for an electric railway franchise.

Redbluff, Cal.—It is reported that E. B. Walbridge has applied for an electric railway franchise, and bids for said franchise will be received Mar. 10 by W. A. Fish, Clk. Bd. Supervs.

Benicia, Cal.—It is reported that Trus. Hertzburn has applied for an electric railway franchise, and bids for said franchise will be received Mar. 24 by E. P. Weinmann, City Clk.

Canon City, Colo.—The City Council has granted a franchise to Geo. W. Baumhoff, of St. Louis, Mo., for the construction and maintenance of an electric railway in this city. It is the intention of the promoters to connect Canon City with Florence by this line.

Lincoln, Ill.—The Lincoln & Mt. Pulaski Interurban Ry. Company has been incorporated, with a capital of $25,000, build an electric railway between Lincoln and Mt. Pulaski. Incorporators: Herman S. Bekemeyer, John C. England and Jos. F. Beidler.

Peru, Ind.—Peru Township has voted a $25,000 subsidy and Richland Township voted $10,000 for the Peru & Warsaw Interurban Ry. The route of the road will be from Chili to Gilead, Akron, and then to Rochester and Warsaw.

Angola, Ind.—Directors of the Angola Ry. & Power Co. have decided to improve the line, which extends from Angola to Lake James. The hotel, which stands on a 40-acre tract of land along the lake, owned by the traction company, will be remodeled and enlarged, or rebuilt. The line will be extended from its present terminal at Angola to the Lake Shore depot.

Des Moines, Ia.—The Des Moines St. Ry. Co. is reported to have decided upon improvements to be made to its system during the year. The Army Post Line will be double-tracked a distance of about 4 miles. The Sixth Ave. line will be double-tracked from Laurel St. to the terminus in North Des Moines, near the Chautauqua grounds. The University Place line will be double-tracked a distance of about 1½ miles. The Grand View Park line will be double-tracked from the State Fair Grounds to Grand View Park, a distance of 1 mile. The belt line from Flint Valley to its intersection with the interurban line, north of Grand View Park, a distance of 3 miles, will also be double-tracked.

Boston, Mass.—The petition of the Maplewood & Danvers Street Ry. Co. and of the Haverhill & Boxford St. Ry. Co. for approval of locations in the highways of Malden, Melrose, Saugus, Lynnfield, Peabody, Danvers, Middleton, Haverhill and Boxford have been approved by the Bd. of State Ry. Comrs.

Lansing, Mich.—The Lansing & Battle Creek Traction Co. is reported formed to construct an electric line between the two points named in the title of this company. Incorporators: Wm. N. Dibble, Geo. A. Hoeltzel and others, of Battle Creek, and Earl B. Hughes, of Marshall.

Plattsburg, Mo.—The County Court has granted a renewal of the franchise of the Kansas City-St. Joseph Electric Ry. Co. for a period of 60 days. Rights of way are reported to have been secured for the proposed line. The central power house is to be located in Platte City.

New York, N. Y.—The Com. on Plans of the Rapid Transit Comn. on Feb. 28 adopted tentatively new subway projects for Manhattan, the Bronx, Brooklyn and part of Queens, which, if all built, will cost from $200,000,000 to $250,000,000. The committee also decided to report a plan for an elevated railroad loop to connect the Brooklyn and Williamsburg Bridges.

The Bd. of Aldermen on Feb. 28 passed the resolution ratifying the franchises for the McAdoo tunnel in 6th Ave. The franchises provide for two extensions of the Hudson River tunnels now being constructed by the New York & Jersey R. R. Co. From the Christopher St. terminal of the river section of the tunnel one double track line is to extend under 6th Ave. to a terminal at 33d St.; the other line is to run under 9th St. to a loop at 2d Ave.

Salisbury, N. C.—It is reported that financing of the Salisbury & Spencer Ry. (pany has been arranged.

Martin's Ferry, O.—The Wheeling Trac Co. has obtained a franchise over a nu of city streets in Martin's Ferry. The pany is planning to change its route to inate curves and grades.

Guthrie, Okla. Ter.—The Knox Eng'g C Chicago, Ill., is reported to have superv of the work on the Guthrie St. Ry., whic now being built here by the Metropo Constr. Co., of which J. W. Shartel, of (homa City, is the head. The system in (rie will eventually be connected with th Oklahoma City by an interurban line.

Johnstown, Pa.—The Northern Cambri Ry. Co., which plans to build in this vici has elected W. H. Deulinger, Pres., and H. Allport, Secy.

Scranton, Pa.—The Scranton, Factory & Tunkhannock Railroad Company has for record a mortgage for $2,000,000. The pany plans to build an electric railway Scranton to Tunkhannock by way of D and Factoryville. One of the future pla the company is to build a spur to Lake ola. J. Seldon Swisher, Pres.

Philadelphia, Pa.—Press reports state the Philadelphia Rapid Transit Co. (V Twining, Ch. Engr., 820 Dauphin St.) completed plans and specifications for extension of Market St. Subway around Hall, and bids for the work will be soon. It is said that it will be a two- subway, covering about ½ mile. The c estimated at $1,000,000.

Pottsville, Pa.—The Tamaqua & Lan St. Ry. Co. will build an overhead brid its Middleport extension west of Bu Grove. The preliminary surveys have re Tuscarora.

Du Bois, Pa.—The Du Bois Electric tion Co. contemplates in the Spring exte its electric railway about 5 miles.

Jersey Shore, Pa.—The Jersey Shore Ry. Co. proposes to install a 225-kw. ra generator. G. P. Nice, Supt., Jersey Sh

Watertown, S. D.—The Watertown T portation Co. has been organized to bu 10-mile electric railway; capital, $10 Alfred L. Rowe and Wm. D. Rowe are re interested.

Memphis, Tenn.—The Memphis St. R is reported to have decided to con about 15 miles of new lines, and expend $300,000 for new equipment.

Danville, Va.—It is stated that an sion is to be built to the lines of the Da Street Ry. & Electric Co.

Spokane, Wash.—The Spokane & Electric Ry., which is being promoted th the Palouse country for 100 miles sou Spokane; the Cœur d'Alene & Spokane tric Ry. and the Spokane Traction Co. joined to form a terminal company to a large passenger building and to own t yards in this city. Two double track b will be built by the lines. They wil about $80,000, and the passenger te building will cost about $200,000.

Wausau, Wis.—G. D. Jones, Karl M G. S. Gilbert and Neal Brown are re interested in the construction of an e railway through the Wisconsin River V reaching Brokaw, Merrill and other poi

Adelaide, Australia.—The governme given notice to the Tramways Compan its intention to purchase the existing horse tramways. The lines will proba converted into a system of electric tr Address Jas. W. Ione, Secy. Comrs. o Wks.

RAILROADS.

Notes Arranged Alphabetically by St

**Ensley, Ala.*—The contract for the struction of the Southern R. R. from Junction to the intersection of the Ensley is reported to have been let t & Co., of Birmingham; the line will be 3 miles in length.

Bridgeport, Conn.—E. T. Buckingham Clk., writes that the following improv are contemplated in connection with th posed $80,000 bond issue: Elevating th road tracks, remodeling city hall, an structing a bridge bet. Fairfield and port. The bridge will cost $25,000, B. Hill, of New Haven, will have ch the bridge.

Atlanta, Ga.—The Louisville & Na R. R. Co. desires to contract for the d of 50,000 cross ties in the city of A and for the delivery of 50.000 cross the city of Cartersville, Ga., as adv in The Engineering Record.

Springfield, Ill.—An ordinance has b troduced in Council providing for th struction of a subway under the tracks Chicago & Alton R. R., at the cross N. 8th St. and Eastman Ave.

Baton Rouge, La.—The Southern Pa R. Co. (Wm. Hood, Ch. Engr., San Fr Cal.) is reported to have decided to co a line from Lafayette to Baton Rouge tance of 50 miles.

Hutchinson, Minn.—The Great Nort R. Co. (A. H. Hogeland, Ch. Engr., St is reported to have in contemplation t struction of a line from Hutchinson t shall, a distance of about 100 miles.

**Brainerd, Minn.*—A. Guthrie & St. Paul, are reported to have secu contract for constructing the Minn International R. R. to the Big Fork distance of 30 miles.

**Items marked thus give the names of parties awarded contracts.*

thome, Minn.—The contract for the ction of a 30-mile extension northf the Minnesota & International R. R. 's present terminus, is reported to have warded A. Guthrie & Co., of St. Paul. ad is controlled by the Northern Pao., and runs north from Brainerd h Bemidji to Northome, the present n terminus, a distance of 154 miles.

ouis, Mo.—The Big River Constr. Co., h A. T. Fisher, Pres., is stated to have petition in the St. Louis County Court franchise to build and operate a standuge railroad, either steam or electric, he southern limits of St. Louis to and h Fenton, to a point at the southern ary line of St. Louis County.

n, N. M.—The Santa Fe, Raton & East- R. Co. has been incorporated, by Frank npison, of New York, N. Y.; Chas. N. and Fred. Pelouze, of Raton, and oth- build, equip, maintain and operate a New Mexico; length of proposed line, les. Principal place of business is

gara Falls, N. Y.—Press reports state steps will probably be taken to relieve ity of dangerous grade crossing. The ing Grade Crossings Comn. is stated to been named by Mayor Cutler: Wm. B. ne, Mighells B. Butler, A. C. Hastings, thers.

g Island City, L. I., N. Y.—Press restate that improvements under way and ntemplation by the Long Island R. R. J. R. Savage, Ch. Engr., Jamaica, N. nd the Pennsylvania R. R. Co. (W. H. n, Ch. Engr., Philadelphia, Pa.) in Long d, will cost about $90,000,000.

oners, N. Y.—Press reports state that lew York, New Haven & Hartford R. R. (Colon M. Ingersoll, Ch. Engr., New n, Conn.) has completed specifications ouble-tracking a 20-mile section of the and division east of Towners, N. Y., bids are being asked for the work, which cost about $600,000.

cinnati, O.—Russell Harding, of Cincin- Pres. of the Pere Marquette R. R., and Pres. of the Cincinnati, Hamilton & Day- R., is reported to have announced the imments decided upon for the Great Cenroute. These improvements call for the nditure of $9,404,237; of this amount will be expended on the C. H. & D., $2,- 00 for improvements and $2,745,659 for ment, and on the Pere Marquette, $2,- 00 for improvements and $2,658,578 for ment.

airview, Pa.—The Pennsylvania R. R. Co. ated to have awarded to H. S. Kerbaugh, of Philadelphia, the contract for gradmasonry and track-laying for two addil tracks on the river side of Northern ral Ry., from north end of present four s at New Cumberland to a connection the main line of the Northern Central near Fairview. The contract includes construction of the undergrade crossing ridgeport. In all, the work is 4½ miles

ittsburg, Pa.—The contract for the contion of the elevated freight line along esne way, Pittsburg, for the Pennsyla R. R., has been awarded to the McClinlarshall Constr. Co., of Pittsburg and stown. It will be 3,700 ft. long, and ision will be made for two tracks.

apid City, S. D.—The Missouri River & hwestern R. R. Co. is stated to have rded to Willis & Detwelter, of St. Louis, the contract for the construction of 26 s of the proposed new railroad from id City to Mystic.

eaumont, Tex.—The Beaumont, Sour Lake Vestern Ry. Co. has applied to the State R. Comn. for authority to issue its stock bonds to the value of its property, as e may be determined by the Commission. s road is chartered from Beaumont to ston. About 85 miles are completed from umont to Sour Lake, 20 miles. It is stathat, as soon as present matters are set, steps will be taken to extend from Sour e to Houston. G. W. Meeker, Gen. Mgr., G. W. White, Ch. Engr., Beaumont, Tex.

leburne, Tex.—The Trinity & Brazos Val- Ry., from Cleburne to Mexia, Tex., has ently been purchased by the 'Frisco Ry. erests, and, it is stated, will be at once npleted north from Cleburne to Ft. Worth, miles, and from Mexia south to Houston Galveston, about 200 miles. Surveys are being made for the location south from xia. R. H. Baker, Mgr., and P. G. Burns, ating Engr., Cleburne, Tex.

ealy, Tex.—The Gulf, Colorado & Santa Ry. Co. (C. W. Felt, Ch. Engr., Galton) has purchased the Cane Belt. R. R. n Sealy to Matagorda, about 90 miles, and v asks authority of the State Legislature consolidate with same. It is stated that former company proposes, in case of conidation, to cross Colorado River at Garod, and build down the west side via El npo and Midfields, about 50 miles, through rice and cane belt. Alvin Snyder is Gen. r. Cane Belt R. R., Eagle Lake, Tex.

Iouston, Tex.—The Galveston, Harrisburg San Antonio Ry. Co. (W. G. Van Vleck, n. Mgr., Houston) is asking authority of State Legislature to consolidate with the Y., T. & M. Ry., S. W. T. & P. Ry. and A. & G. Ry. The latter road extends from n Antonio northeast to Stockdale, about 39 les. The company agrees to build same to ero, about 40 miles, in case the consolidan is authorized.

Norfolk, Va.—The City Council is reported have voted to appropriate $95,000 to guartee a right of way from the southern anch of the Elizabeth River to Sewall's int, a distance of 13 miles, to be used by e Tidewater Ry. This action gives the railay a deep-water terminus for a trunk line at will extend from the lakes to the Atlan- seaboard; total cost of the road will be out $50,000,000.

Moncton, N. B.—Press reports state that Attorney John McLennan, Syracuse, N. Y., has incorporated the Canadian Constr. Co., with a capital of $1,000,000, to build sections of the Grand Trunk Pacific R. R. The Grand Trunk Pacific is a new road, to be built partly under Canadian government. It will run from Moncton, N. B., on the east, to a point on the Pacific coast in British Columbia on the west.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Anniston, Ala.—The following are the 3 lowest bids opened on Feb. 25 by the Superv. Archt., Treas. Dept., Washington, D. C., for a low-pressure steam-heating apparatus for the U. S. Post Office at Anniston: D. A. Tompkins Co., Charlotte, N. C., $3,060; Liddell Htg. Co., Montgomery, $3,475, and Corson-Payson Co., Danville, Ill., $3,693.

Montgomery, Ala.—The Advisory Bd. of the City Infirmary, it is reported, has petitioned the City Council to erect a new city hospital at a cost of about $20,000.

Tucson, Ariz.—See "Water."

Lake Village, Ark.—Frank W. Gibb, of Little Rock, it is reported, has prepared plans for a 2-story brick court-house, 40x60 ft., to be erected in Chicot County, at a cost of $40,000. W. G. Streett, Co. Judge.

San Francisco, Cal.—See "Sewerage and Sewage Disposal."

Los Angeles, Cal.—John C. Austin, Douglas Bldg., it is reported, has completed plans for a $50,000 detention hospital.

Denver, Colo.—The Bldg. Com., it is reported, has received revised plans for the new public library, and as soon as they are approved, it is stated that bids will be asked for the erection of same. The cost to be about $250,000. Frank W. Crocker, Chmn.; Albert R. Ross, N. Y. City, archt.

Bridgeport, Conn.—See "Railroads."

Washington, D. C.—An appropriation of $18,668 has been placed in the District of Columbia Appropriation Bill, for the reconstruction of the National Homeopathic Hospital.

St. Augustine, Fla.—The Co. Comrs. are considering the erection of a new or the rebuilding of the present court-house.

Atlanta, Ga.—The Presbyterians, it is stated, are contemplating erecting in the near future a new building for the Presbyterian Hospital, to cost $50,000.

Waycross, Ga.—The erection of a new city hall is reported under consideration.

Chickamauga Park, Ga.—Capt. C. Nixon, Q. M., U. S. A., Chattanooga, Tenn., writes that all bids opened on Feb. 11 for constructing, plumbing and gas piping a lavatory building at Chickamauga Park have been rejected, and new bids will be received on Mar. 20, as advertised in The Engineering Record.

Chicago, Ill.—Plans are being prepared for the police station which is to be erected at Michigan Boule. and 14th St., at a cost of $150,000.

Chicago, Ill.—The Bd. of Directors of the John Crerar Library Assoc., it is reported, are considering the erection of a library in Grant Park, to cost about $1,000,000.

Indianapolis, Ind.—J. T. Johnson, 1113 State Life Bldg., has prepared plans for an engine and hose house to be erected by the city, to cost $15,000.

Kentland, Ind.—Press reports state that bids will be received Apr. 3 by Alonzo E. Purkey, Aud., for $25,000 court house bonds.

Auburn, Ind.—Wing & Mahurin, of Ft. Wayne, it is reported, have prepared the plans and will supervise the construction of the DeKalb County Infirmary.

Sioux City, Ia.—It is reported that the Bd. of Superv. is considering the erection of a new court house, at a probable cost of $80,000.

**Henderson, Ky.*—J. E. Barnes, of Logansport, Ind., has secured the contract for erecting the U. S. Post Office at Henderson, for $37,700.

Plaquemine, La.—The Com. appointed by the Police Jury to receive plans for the new court house has accepted those submitted by Andrew J. Bryan, of New Orleans. Probable cost, $37,000.

New Orleans, La.—A motion has been adopted by the City Council authorizing the City Engr. to prepare plans and specifications for repairing the City Hall, the cost not to exceed $15,000.

Baltimore, Md.—Herbert G. Crisp is said to be archt. for the Franklin Sq. Hospital which is to be erected in the spring at Calhoun and Fayette Sts., of brick and marble. The probable cost is reported to be $30,000. Dr. J. A. Gilmer is to be the resident physician.

Plans have been submitted for a group of buildings for the Egenton Female Orphan Asylum, which include a central administration building 80x64 ft., and 2 cottages each 70x70 ft.

Marblehead, Mass.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., on Apr. 6 for the construction, including plumbing, heating apparatus, electric wiring and conduits, the U. S. Post Office at Marblehead, as advertised in The Engineering Record.

Attleboro, Mass.—The Bd. of Trus. of the Pub. Library, it is stated, intend erecting a library on N. Main Ct., to cost about $50,000.

Detroit, Mich.—Bids are wanted Mar. 22 for furnishing material and constructing a concrete foundation for combined tower and dwelling at the Saginaw River Range near Light Station. Maj. Lansing H. Beach, Corps Engrs., U. S. A.

Grand Rapids, Mich.—Bids will be received Mar. 22 by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for installing a plumbing system in U. S. Post Office and Custom House here.

Menominee, Mich.—D. Hubert, of Menominee, it is stated, has prepared plans for an addition to the St. Joseph Hospital, which is to cost $30,000. Sister Elizabeth, Superior.

Alpena, Mich.—It is stated that bids will be received until Mar. 27 by the Bldg. Com. (Mayor Frank C. Holmes, Chmn.), for erecting a city hall. Clark & Munger, archts., Shearer Bldg., Bay City.

St. Paul, Minn.—The Senate has passed a bill appropriating $30,000 for the completion of the south wing at the State Reformatory.

**Albert Lea, Minn.*—It is reported that the contract to erect the U. S. Post Office has been awarded to Butler Bros., of St. Paul, Minn., at about $24,500.

New Albany, Miss.—Bids will be received Mar. 9 by the Bd. Co. Supervs. for erecting a jail. C. S. Cullins, Clk.

**Natchez, Miss.*—The Mankin Constr. Co., of Richmond, Va., has secured the contract for constructing complete the U. S. Post Office at Natchez (bids opened Feb. 9), for $34,164.

Bonneville, Miss.—Court-house bonds, amounting to $25,000, have been sold conditionally, the question of their issuance to be settled at a special election to be held on Mar. 9.

St. Louis, Mo.—The Bd. of Directors of the Pub. Library, it is reported, has engaged Theo. C. Link, Carleton Bldg., to prepare plans for the first branch library to be erected at Jefferson and Lafayette Aves., which is to cost, including furnishings, about $75,000.

Columbia, Mo.—The following are the bids opened on Feb. 27 by the Superv. Archt., Treas. Dept., Washington, D. C., for constructing complete U. S. Post Office at Columbia: J. F. Short, Jefferson City, $31,300; J. W. Wilson & Son, St. Louis, $30,000; G. B. Phillips, Columbia, $30,000; Latimer & Bennings, Kansas City, $27,189; English Bros., Champaign, Ill., $27,187; Dietz & Weitzel, Joplin, $27,467; Morse Constr. Co., Topeka, Kan., $28,637; Paducah Constr. Co., Paducah, Ky., $28,870, and M. B. McDaniel, Columbia, $34,650.

Omaha, Neb.—Local press reports state that bids will be received Mar 15 by the Auvisory Bd., for erecting fire engine house on 24th and Cuming Sts.; approximate cost $25,000.

**Fulton, N. Y.*—D. E. Wadsworth, of Fulton, it is stated, has received the contract to erect the 3-story and basement Carnegie Library, and E. J. Carver, of Fulton, the contract for the masonry, the total cost to be about $15,000.

Albany, N. Y.—It is reported that the following are the bids received Feb. 20 by the Bd. Contract and Supply for erecting a smallpox hospital: Entire work—Wm. J. McCann, $23,270; Morris Kantrowitz, $24,700; Peter Keeler Bldg. Co., $21,941; Collins Bros., $21,627; John J. Kelly, $19,694; John Dyer, Jr., $24,300; Cameron & Hawn Realty Co., $27,473; M. L. Ryder Bldg. Co., $23,851; Jas. C. Nolan, $23,170.

Bids were also received on portions of the work, they being, according to report, as follows: Mason work—Peter Keeler Bldg. Co., $12,033; Henry Fisher, $14,600. Carpenter work—Jas. H. White, $6,750; A. H. Reiner, $5,200; Henry Kronou, Jr., $6,475; Gus Hahn, $8,372. Plumbing work—Jerry Kieley, $2,031; Jas. D. Walsh, Jr., $1,683; John L. Fitzgerald, $1,480. Heating work—M. L. Ryder Bldg. Co., $1,735; John L. Fitzgerald, $1,850; Edw. P. Bates, $2,300.

**Tompkinsville, S. I., N. Y.*—The following are the bids opened on Feb. 9 by Lieut.-Col. Wm. T. Rossell Corps Engrs., U. S. A., for building a coal shed at the Light-House Depot—*a*, brick structure; *b*, steel structure: Jas. C. McGuire Co., New York, *a*, $18,342; *b*, $18,242. Ralph J. F. Gerstle Co., New York, *a*, $20,487; *b*, $18,734. J. C. Vreeland Bldg Co., New York, *a*, $17,768; *b*, $19,601. Smith & Robinson, New York, *a*, $14,678; *b*, $15,873. Conrad Hewitt, New York, *a*, $17,700; *b*, $18,700. Penn Bridge Co., Beaver Falls, Pa., *b*, $13,887 (awarded contract). Chas. Meads & Co., New York, *a*, $17,800; *b*, $19,970. Geo. Vassar's Sons & Co., New York, *a*, $22,240; *b*, $26,041. John Thatcher & Son, Brooklyn, *a*, $18,500; *b*, $22,390. N. Eastern Constr. Co., New York, *a*, $16,380; *b*, $19,984. R. P. & J. H. Staats, Inc., New York, *a*, $21,000; *b*, $23,900. Philip Wolfe & Son, Stapleton, *a*, $16,543. The Snare & Triest Co., New York, *a*, $14,680; *b*, $15,680. Frank Rinschler, Stapleton, *a*, $18,933; *b*, $18,908.

Towner, N. D.—The erection of a court house, at a cost of $30,000, to replace the structure which was destroyed by fire, is reported under consideration.

Gallipolis, O.—Bids will be received Mar. 21 by the Bd. Co. Comrs., for $10,000 bonds to be used for erecting a building for infirmary purposes. J. T. Hanson, Co. Aud.

Toledo, O.—The erection of a municipal barn at a cost of about $40,000 is reported under consideration.

**Pittsburg, Pa.*—John Siebert, Sons & Co., 1700 Jane St., it is reported, have received the contract to erect No. 7 engine house at Penn Ave. and 23d St., at about $13,500. The contract for the hot-water plant has been secured by Maginnis & Co., at $1,767.

New Castle, Pa.—It is reported that an $18,000 engine-house is to be erected at Central Station, to replace present building.

Allegheny, Pa.—See "Sewerage and Sewage Disposal."

Camden, S. C.—Bids will be received until Mar. 7 by the Co. Comrs., for $25,000 court house bonds. J. M. Sowell, County Superv.

Memphis, Tenn.—The citizens of Shelby County on Feb. 20 voted to issue $1,000,000 bonds for a new court-house and site. Address N. C. Perkins, Court House.

Lynchburg, Va.—It is reported that the City Council is considering the erection of a new city hall, at a cost of about $100,000.

Ft. Monroe, Va.—Bids will be received Mar. 15 by C. P. Townsley, Q. M., for constructing storehouse at this post.

Ft. Wright, Wash.—D. M. McInnis, it is reported, submitted the lowest bid for erecting a lieutenant's quarters and frame wagon shed here, including plumbing, heating and electric wiring, at $24,454. E. A. Shuttleworth, Constr. Q. M., Spokane, Wash.

**Ellsworth, Wis.*—J. Moody, Chmn. Bldg. Com., writes that contracts for the erection of a court house for Pierce County have been awarded as follows: Plumbing and heating to Holt & Dahlby, St. Paul, Minn., $6,382; electric wiring, Bruck Bros., Ellsworth, $1,313; jail work, shutters and vault to Diebold Safe & Lock Co., St. Paul, Minn., $3,265, and construction proper, Chas. Skeoglum, of St. Paul, Minn., $64,784. The other bids received on the construction proper are as follows: Newman & Hoy, St. Paul, Minn., $86,619; General Constr. Co., Milwaukee, Wis., $73,863; Chas. A. Moses, Chicago, Ill., $76,018; Winchester & Cullen, Janesville, Wis., $78,779; Chippewa Falls Constr. Co., Chippewa Falls, Wis., $73,427; P. Kircher & Son, Hudson, Wis., $73,476; Butler Bros., St. Paul, Minn., $87,695; Fred. Norlander, St. Paul, Minn., $64,906; O. H. Olsen, Stillwater, Minn., $69,634, and Wm. Porter, St. Paul, Minn., $72,990.

London, Ont.—Bids will be received Mar. 9 by Fred Gelinas, Secy. Dept. Pub. Wks., Ottawa, for alterations and additions to post office here. H. C. McBride, Archt., London.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—W. H. Woodward and Assoc., it is stated, have purchased a site at 20th St. and 4th Ave. and intend erecting a 12-story hotel to cost about $500,000.

Mobile, Ala.—It is reported that Frank A. and Chas. B. Hervey, of Chattanooga, Tenn., are contemplating the erection of a hotel at St. Francis and Conception Sts., to cost about $550,000.

Pine Bluff, Ark.—Bateman Atkinson, it is reported, has prepared plans for a 2-story brick building which the J. B. Speers Co. intends erecting at 3d and Chestnut Sts., at a cost of $25,000.

Little Rock, Ark.—Frank W. Gibb, 112 Louisiana St., is preparing plans for the completion of the Y. M. C. A. building at 5th and Scott Sts.

San Francisco, Cal.—A 6-story office and warehouse to cost $100,000 is to be erected on Beale and Mission Sts., for Mrs. Margaret H. Fuller. Albert Pissis, archt., 307 Sansome St.

Denver, Colo.—The Denver Dry Goods Co., it is stated, is contemplating the erection probably next fall, of an 8-story steel and pressed brick building to be erected on California St. adjoining their present building, the cost to be about $300,000.

The Juvenile Court Improv. Assoc., it is stated, intends erecting a club house for the juveniles with the $20,000 pledged by Simon Guggenheim.

The Colorado Bldg. & Investment Co., it is stated, has purchased the site at 17th and Champa Sts., and intends erecting an 8-story office building to cost about $400,000. Henry M. Porter, Julius A. Myers and Chas. Boettcher are among the directors of the company.

Augusta, Ga.—It is reported that improvements are to be made this summer to the Hotel Bon Air which are to cost about $150,000. It is stated that at an early date archts. will be requested to submit plans for these improvements. Capt. Wm. B. Young may be able to give further information.

Atlanta, Ga.—Asa G. Chandler, it is reported, has purchased the property at 165 Peachtree St., and it is stated, contemplates erecting either a 7 or 8-story department store.

Chicago, Ill.—It is reported that the members of the Marquette Club are contemplating the erection of an 8-story building on Dearborn Ave. and Maple St., to cost $85,000.

*The Thompson-Starrett Co., 51 Wall St., N. Y. City, it is reported, has received the contract to erect the Illinois Athletic Club building, a 12-story structure, on Michigan Ave., at an approximate cost of $500,000.

The National Box Co. will enlarge its plant at 38th St. and Center Ave. by a 2-story addition, 225x95 ft., of mill construction, to cost $70,000.

It is reported that the Briggs Hotel Co. intends reconstructing the Briggs House, at an approximate cost of $50,000. Wm. M. Knight, Pres.

Holabird & Roche, 1618 Monadnock Bldg., are preparing plans for a 5-story store and office building to be erected at Canal and Madison Sts. for Ida Richardson, at a cost of $40,000.

The directors of the Commercial National Bank, it is reported, have purchased a site at Clark and Adam Sts., and intend erecting a 16-story building.

**Peoria, Ill.*—J. L. Flinn, 134 S. Washington St., it is reported, has received the contract to erect a $35,000 amphitheatre at Lake View Park.

Belleville, Ill.—It is stated that the Kronthal Liedertafel Society (Albert Wilhelm, Secy.), has decided to erect an opera house to cost $30,000.

Freeport, Ill.—The parishioners of St. Joseph's R. C. Church, it is reported, are contemplating the erection of an orphan asylum, to cost about $25,000.

Items marked thus give the names of parties awarded contracts.

East St. Louis, Ill.—The Masonic Hall Assoc. has been incorporated, to erect a building for lodge purposes. H. J. Eggman is reported interested.

It is reported that the directors of the First Natl. Bank intend erecting a $100,000 building at Collinsville and Missouri Aves. It is to be 6 stories high, the first floor to be occupied by the bank and the upper floors by offices.

The Mounds Park Sanatorium Assoc., it is stated, is contemplating the erection of a sanatorium for chronic and nervous diseases, to be erected on Thorne and Hiawatha Sts. Dr. R. O. Earl may be able to give further information.

Russell A. Richardson, it is stated, is having plans prepared for a 3-story store and office building, 50x175 ft., which is to be erected to replace the structure which was recently destroyed by fire. Probable cost, $50,000.

Jas. K. Ramsey, of St. Louis, Mo., it is reported, has prepared plans for a 2-story and basement brick store and office building which is to be erected at Collinsville and Division Aves., at a cost of $18,000.

Englewood, Ill.—The Englewood Men's Club will build a 2-story gymnasium in connection with its club-house at 63d St. and Harvard Ave.; probable cost, $20,000.

South Bend, Ind.—The Oliver Chilled Plow Works proposes erecting a 5-story warehouse 150x400 ft.

Evansville, Ind.—Anton Kessler, it is reported, submitted the lowest bid for erecting the Inglehart flour mill here at $22,272.

*Christ. Kanzer, 917 E. Illinois St., it is reported, has secured the contract to erect for the American Bank & Trust Co. a bank building at Main and 6th Sts., to cost $38,000.

**Indianapolis, Ind.*—Lynn B. Millikan, 291 Stevenson Bldg., it is reported, has received the contract to erect the 8-story brick and terra cotta building for the Van Camp Hardware & Iron Co. at Missouri and Maryland Sts., which is to cost about $300,000. H. C. Brubaker, Jr., Aetna Bldg., is the archt. and W. K. Eldridge, Aetna Bldg., the Engr.

Fire on Feb. 19, it is reported, destroyed several buildings on the block bounded by Meridian, McCrea and Louisiana Sts. Owners of the buildings destroyed, it is stated, are planning to rebuild at once, among them being Griffith Bros., The Kiefer Drug Co., and Fahnley & McCrea.

Michigan City, Ind.—Brinkman Bros. will erect a 2-story automobile garage, 42x125 ft.

Muskogee, Ind. Ter.—Dr. E. W. Brown, of Jackson, Miss., it is reported, intends erecting a 3-story stone store and office building on S. 2d St., to cost about $35,000.

Des Moines, Ia.—Liebbe, Nourse & Rasmussen, 724 Walnut St., it is stated, are preparing plans for a 6-story warehouse which is to be erected at First and Court Sts., as an addition to the Warfield-Pratt-Howel Co.'s Bldg. Cost $40,000.

John A. Garver, it is stated, is considering the erection of a 3 or 4-story business block on Locust and 7th Sts. to cost about $50,000.

Sioux City, Ia.—Plans are being prepared, according to reports, by Liebbe, Nourse & Rasmussen, of Des Moines, for a 6-story building which the Warfield-Pratt-Howel Co., of Des Moines, intends erecting at 3d and Jones Sts.

Local press reports state that bids are to be opened Mar. 16 for erecting the Iowa State National Bank at 5th and Pierce Sts. J. Walter Stevens, of St. Paul, Minn., is the archt.

Cedar Rapids, Ia.—It is stated that bids are wanted Mar. 15 for interior work, plumbing, elevators, electric motors, heating, etc., for Cedar Rapids Hotel. Josselyn & Taylor Co., Archts., 213 S. 3d St.

Danville, Ky.—It is reported that a Y. M. C. A. building is to be erected here within a short time, the cost to be about $25,000.

New Orleans, La.—The freight terminals of the Illinois Central, including grain elevators, sugar sheds, and the cotton warehouses along the river front for nearly a mile, it is reported, have been destroyed by fire, and it is stated to be the intention of the company to rebuild at once. H. U. Wallace, Ch. Engr., Chicago, Ill.

Boston, Mass.—Plans have been filed for a 4-story brick and stone 4-family tenement and stores, to be located at 101 Mt. Vernon St., Roxbury Dist., at an estimated cost of $20,000. Owner, H. E. Fuller; builder, J. Schoolman, both at 9 Cornhill; architect. Hurd & Gore, 110 Tremont St.

Whitman, Mass.—It is reported that the Jenkins block has been destroyed by fire.

Salem, Mass.—It is reported that plans have been prepared for a building to accommodate the probate court and the registry of deeds which is to be of brick and cost about $300,000.

Worcester, Mass.—The erection of a passenger station on Washington Sq. to cost about $400,000 is reported under consideration. City Solicitor Arthur P. Rugg may be able to give further information.

Boston, Mass.—Plans have been filed by the State St. Trust Co., 38 State St., for a 6-story limestone and terra-cotta fireproof building to be erected on Massachusetts Ave. and Boylston St. Architects, Allen & Collins, 6 Beacon St.

**Holyoke, Mass.*—The contract for the new weave shop to be erected for the Farr-Alpaca Co., is reported to have been awarded to Andrew D. McCormick, 27 Congress Ave. It will be 2 stories high, of mill construction, 193x230 ft., with a ribbed-glass roof; a power plant of 1,500 h.p. will be installed.

Boston, Mass.—Plans have been filed for a "Sailors' Haven" to be erected by the Episcopal Missions on Water St., Charlestown; it will be 3 stories high, of brick, and cost about $20,000. Architects, Allen & Collins, 6 Beacon St.

**East Charlemont, Mass.*—Chester N. Tyler, of Orange, it is reported, has received the contract to erect a 5-story, 221x56-ft. brick building for the New Home Sewing Machine Co.

St. Paul, Minn.—The Pythian Castle Hall cester, it is stated, has received the contract to erect a building at Nantasket beach which is to cost $75,000.

Detroit, Mich.—It is reported that the plant of the Detroit Steel Casting Co., at 1243 Michigan Ave., was destroyed by fire on Feb. 19.

Benton Harbor, Mich.—The erection of a city hall at a cost of about $40,000 is reported under consideration.

Minneapolis, Minn.—It is stated that a building to cost $75,000 is to be erected for the boys' dept. of the Y. M. C. A.

Jackson, Miss.—The Pythian Castle Hall Assoc., it is reported, has been organized in this city for the purpose of erecting a Pythian Bldg. on Capitol St., to cost $30.000.

Meridian, Miss.—Reports state that bids will be received Mar. 20 by the Meridian Terminal Co. (C. C. Harvey, of New Orleans, La., Pres.), for erecting a 45x200-ft. union depot; probable cost $200,000. Frank P. Milburn, Archt., Columbia, S. C.

Vicksburg, Miss.—The directors of the First Natl. Bank are considering plans for an 8-story building which they propose erecting at an estimated cost of $65,000.

Hannibal, Mo.—Barnett, Haynes & Barnett, of St. Louis, it is stated, have prepared plans for a 4-story hotel, which is to be known as the Mark Twain Hotel, and is to be erected on Main St., at a cost of $70,000.

Kansas City, Mo.—The Kaw Land Co. will erect a 6-story brick building at 1108-10 McGee St., to cost $75,000. J. C. Gates will erect a $75,000 building, 5 stories high, at 10th St. and Grand Ave.

St. Louis, Mo.—The Adolphus Busch Glass & Mfg. Wks., at Main and Dorcas Sts., it is reported, has been completely destroyed by fire.

Plans have been submitted to the Bldg. Comr. for a 6-story warehouse to be erected at S. Main St. and Clarke Ave. for the Morgan-Crunden Woodenware Co.

Dillon, Mont.—The officials of the Oregon Short Line, (E. Buckingham, Gen. Supt., Salt Lake City, Utah), are said to be contemplating the erection of a depot in this city to cost $50,000.

Brooklyn, N. Y.—The Academy of Music Corporation, it is stated, has invited 10 archts., including Frank Freeman, Geo. L. Morse, Wm. M. Tubby and Lord & Hewlett, all of Brooklyn, to submit plans in competition for the new Academy of Music.

Astoria, L. I., N. Y.—The Title Guarantee & Trust Co., it is reported, has purchased a site here and intends erecting a 6-story building to be used exclusively by the company.

New York, N. Y.—The members of the Automobile Club of America, it is reported, have purchased a site on 54th St. west of Bway., on which it is proposed to erect a new club-house and garage, the cost of land and building to be about $500,000. Ernest Flagg, 35 Wall St., is the archt.

The members of the N. Y. Cotton Exchange, it is stated, have voted to appropriate $94,000 for alterations to be made to the present Exchange Bldg.

Cleveland, O.—An ordinance has been passed by the City Council authorizing a bond issue of $20,000 for bathhouse purposes.

Sandusky, O.—It is reported that Jos. Singler, Mgr. Nielson Theater, has announced that he and Edw. H. Smith expect to erect a playhouse here next season, to cost $25,000.

**Toledo, O.*—The H. J. Spieker Co., it is reported, has received the contract to erect a 4-story and basement building on Madison Ave., for A. W. Colton, to be used for stores and offices, and to cost about $100,000.

*It is stated that the Donovon Wire & Iron Wks., 505 Water St., have received the contract for the iron and steel to be used on the Nicholas Bldg., the cost reported to be about $200,000.

Akron, O.—The Grand Opera House, owned by T. K. & W. A. Albaugh, it is stated, has been destroyed by fire.

Dayton, O.—The Troy-Pearl Laundry Co. has just been incorporated with a capital of $150,000. The company, it is stated, will erect a 3-story building at Ziegler St. and the canal, at a cost of about $100,000. Incorporators, Thos. A. Seiz, John E. Reed and others.

Columbus, O.—The directors of the American Savings Bank, it is stated, have leased the site at High and Town Sts., and intends erecting a 6-story building, to cost $80,000.

Cincinnati, O.—McLaughlin & Gilmore, it is stated, are preparing plans for a 7-story building which is to be erected at 6th and Race Sts. for The Fair, at a cost of about $40,000.

Bids will be received Apr. 3 by the Trus. of Cincinnati Southern Ry., 57 Ingalls Bldg., for erecting a concrete freight station consisting of a 2-story office building 45x130 ft., an outbound freight house 25x1,100 ft., an inbound freight house 42x1,100 ft., and a platform 8 ft. wide and 1,060 ft. long bet. tracks. Stanley Ferguson, Secy.

The Fireproof Storage Co. has applied for a permit to erect an 8-story and basement brick, stone and concrete warehouse, on May and Oak Sts., estimated to cost $75,000, and Chas. Moser for a permit to erect a 7-story and basement building at 9th and Pancross Sts., estimated to cost $55,000.

Youngstown, O.—The directors of the First Natl. Bank, it is stated, will erect a building on W. Federal St., estimated to cost $100,000.

The plans for the passenger station to be erected by the Erie and the Pittsburg & Lake Erie Railroad Companies provide for a 3-story structure, 240x120 ft., estimated to cost $50,000.

Massillon, O.—See "Power Plants, Gas and Electricity."

Portsmouth, O.—John Jones, it is stated, proposes to erect on Chillicothe St., a 3-story hotel to cost about $20,000.

Bowling Green, O.—It is reported that the Toledo, Bowling Green & Southern Traction Co. is preparing to erect a passenger and freight station here. E. Darrow, Ch. & Elec. Engr., Findlay, O.

Cleveland, O.—J. Milton Dwyer, Cuyahoga Bldg., it is stated, has been engaged to prepare plans for a 3-story brick and stone building which it is proposed erecting on Prospect St. to be used as a music hall. It is to have a seating capacity of about 3,000 persons.

Dunmore, Pa.—The Dunmore Lumber Co. contemplates erecting a warehouse. P. Mulherin, Pres.

Germantown, Pa.—The Germantown Trust Co., it is stated, is having plans prepared by Brockie & Hastings, of Philadelphia, for a 2-story addition which it is proposed erecting to its banking house on Main St. and Chelten Ave., at a cost of about $30,000. It is reported that bids will be asked about Apr. 1.

**Philadelphia, Pa.*—R. C. Ballinger & Co., 218 N. 13th St., have secured a permit to make alterations to a restaurant at 1024 Chestnut St. at a cost of $24,000.

Archt. Carl P. Berger, Penn Square Bldg., writes that plans will be ready for bids about Mar. 4 for the erection of the German Theater on Girard Ave. and Franklin St. According to press reports, the structure will cost $150,000.

The members of the Academy of Natural Science are said to be contemplating the erection of an addition to its building at 19th St., at an estimated cost of $200,000.

*Geo. L. Sipps, 912 Locust St., has secured a permit to erect a 5-story warehouse at 117 S. 2d St., for Thos. Roberts; cost $40,000.

Pittsburg, Pa.—F. C. Saur, Hamilton Bldg., it is stated, has been selected as the archt. to prepare plans for the building to be erected at Shady Ave. and Aurelia St. for the Natatorium Co. at a cost of about $100,000.

Ambridge, Pa.—The Hotel Ambridge Co., it is stated, has been granted a charter to erect a hotel here. Capital $35,000. F. Ritchey Cluley, Albert E. Beck and Ernest Dugan, of Pittsburg, are the directors.

Sioux Falls, S. D.—W. L. Dow & Son, of Sioux Falls, it is stated, have prepared plans for a 3-story stone store and office building which Wm. Paulton will erect at Phillips Ave. and 11th Sts.

Memphis, Tenn.—The Italian Society will erect a building, to cost $30,000. Address A. A. Chighizola, of Memphis.

Nashville, Tenn.—It is reported that the Hermitage and University Clubs have consolidated, and it is stated, are contemplating the erection of a new building at a probable cost of $100,000.

Knoxville, Tenn.—Thos. H. Morgan, of Atlanta, Ga., is said to be preparing plans for a 10-story stone, steel and marble bank building which the Mechanics Natl. Bank intends erecting on Gay St. at cost of about $200,000.

Belton, Tex.—It is reported that the Grand Opera House, which was recently destroyed by fire, is to be rebuilt. Mr. Head, Mgr.

Dallas, Tex.—The members of the 150 Club, it is stated, are contemplating the erection of an auditorium at a cost of about $150.000. Geo. A. Robertson, Chmn. Auditorium & Bldg. Com.

*Alex. Watson, it is stated, has secured the contract to erect a 2-story brick building for the Southern Banking & Trust Co., at a cost of about $20,000.

El Paso, Tex.—The directors of the Y. M. C. A., it is stated, are preparing to erect a $50,000 building. E. M. Bray, Pres.

**Lynchburg, Va.*—The contract to erect the 7 story fireproof Krise banking and office building at 9th and Main Sts., it is stated, has been awarded to C. W. Hancock & Son, of Lynchburg at about $150,000.

Mrs. Geo. M. Jones, it is stated, has given $50,000 to erect a library as a memorial to her late husband, and has also given $50,000 as an endowment fund for the library.

Richmond, Va.—The erection of a Y. M. C. A. building, at a probable cost of $100,000, is reported under consideration.

Garfield, Wash.—L. E. Carter, it is stated, is interested in the project to erect a brick hotel here to cost about $20,000.

Seattle, Wash.—Jas. Stephen, 724 N. Y. Blk., it is stated, has prepared plans for a 3-story brick business block which is to be erected on 4th Ave. and Madison St., at a cost of $25,000, and also plans for a 4-story pressed brick hotel which is to be erected on Pike St, at a cost of $45,000.

It is stated that the Northern Pacific Railway Co. has announced that it will immediately begin the construction of eight 6-story buildings, each of them occupying half a block, all to be erected upon the railroad's property in the wholesale district of the city. The improvements will cost $2,000,000.

*The contract to erect the Labor Temple on 6th and Univ. Sts., it is reported, has been awarded to T. L. Cannon, at about $21,000.

**Walla Walla, Wash.*—It is reported that S. F. Henderson, of Walla Walla, has secured the contract to erect a 2-story brick building for the Enterprise Lodge of Odd Fellows, at about $18.500.

Spokane, Wash.—See "Electric Railways."

Madison, Wis.—The officials of the Chicago & Northwestern R. R., it is stated, intend making improvements in this city, which will include the erection of a freight depot this summer, and a passenger station next fall. W. A. Gardner, Gen. Mgr., Chicago, Ill.

Horicon, Wis.—It is reported that the building of the Van Brunt Mfg. Co.'s has been destroyed by fire.

Chippewa Falls, Wis.—The Chippewa Constr. Co., it is stated, is considerin erection of an opera house at Bridge Willow Sts., to cost about $50,000. Hansen may be able to give further inf tion.

Brandon, Man.—Bids are wanted Ma for furnishing material for erecting a 4- brick Y. M. C. A. building; bids to be su ted separately for masonry, carpentry, work, sheet metal, composition roofing, tric lighting, plumbing, electric light fix etc. A. E. McKenzie, Secy. Bldg. Com., C. A.

Montreal, Que.—It is reported that Morgan & Co. have purchased propert joining, and intends enlarging the Co House, at a cost of $1,000,000.

CHURCHES AND DWELLING

Notes Arranged Alphabetically by Sta

San Francisco, Cal.—The congregati Beth Israel, it is reported, will erect a 000 synagogue.

**Rockville, Conn.*—The H. Wales Co., of Meriden, it is reported, has re the contract to erect a brick and ston fice for the St. Bernard's Parish, to about $60,000.

Springfield, Ill.—It is stated that the bers of the Second Presbyterian Churc planning to erect a new edifice to cost 000. Address Pastor.

Streator, Ill.—The members of the S Catholic Church, it is stated, are conten ing the erection of a new edifice to cost 000. Address Pastor.

**Alton, Ill.*—The Trus. of the Unit Church, it is reported, have awarded th tract to erect a new edifice at 3d and Sts. to A. Lundstrum, of Joliet, at $20,000.

Chicago, Ill.—Thos. McCall, 167 Dea St., has prepared plans for a flat to be at Spaulding Ave. and W. Madison St will be 3 stories high, 91x60 ft., and $40,000.

A. E. Norman has prepared plans f apartment building to be built at Ke and Foster Aves. for Alfred E. Westma will be a 3-story structure, 50x130 ft., cost $35,000.

Plans have been prepared by Wm. G. 84 Washington St., for the new church built by the R. C. Trinity congregation Rev. Father Sctuezko, pastor, at Noble Chapin Sts. The building will be a fire structure of stone and steel, with slate Estimated cost, $150,000.

**Peru, Ind.*—It is reported that Goodall has secured the contract to erec Presbyterian Church at about $38,000.

Muncie, Ind.—It is reported that Ed Ball will erect a $75,000 residence.

Indianapolis, Ind.—Brown & Davis, dick Bldg., Cincinnati, O., it is stated preparing plans for a brick Baptist Ch to cost $100,000.

W. H. Liddall will erect a residence, cost of $11,500.

Des Moines, Ia.—C. E. Eastman Co. servatory Bldg., it is stated, has com plans for a synagogue, to cost $15,00 Oransky, Chmn. Bldg. Com.

Storm Lake, Ia.—Rev. W. J. Carr, of the Methodist Episcopal Church, it ported, has announced that the congreg is contemplating the erection this summ a new edifice to cost $20,000.

Baltimore, Md.—It is reported that Strawbridge M. E. Church will erect a fice, to cost $20,000. Rev. C. E. Gu Pastor.

Boston, Mass.—Plans have been filed stone church, to be erected at 20 Wi St., Roxbury Dist. It will be 1½ stories, slated roof; estimated cost $25,000; o St. Marks English Lutheran Church, Mosser, Chmn. Bldg. Com., 89 Elm Hill architect, Gay & Proctor, 21 Bromfield

**Duluth, Minn.*—John Grandy, Bu Bldg., it is reported, has received the tract to erect a dwelling for A. L. Orde Superior and 23d Sts., the cost to be, sive of plumbing and heating, $20,000.

Minneapolis, Minn.—Geo. Harrison, stated, will erect a 4-story apartment at Mary Pl. and 11th St., to cost $75,0

Newark, N. J.—Geo. F. King, 745 St., it is stated, has purchased a site at sey and Warren Sts., and contemplates ing an apartment house to cost $50,000

New York, N. Y.—Henry Phipps, stated, has purchased a site at 63d and Sts. and West End and Amsterdam Aves will erect 10 model tenements at a co about $300,000. Robert W. De Fore Chmn. of the Executive Com. of the having the matter in charge, and it is has announced that no plans have as yet drawn for the buildings.

Cincinnati, O.—Wm. W. Franklin, Bldg., it is stated, is the archt. for an ment house which John J. Ryan will ere McMillan St. and Park Ave., to cost $5

Dayton, O.—The members of the Lut Church, it is stated, contemplate erecti edifice to cost $50,000.

Glenrock, Pa.—The congregation of Zion Lutheran Church, it is reported, erect a new edifice at a cost of $20,000.

Pittsburg, Pa.—John McSorley, the er, it is reported, has secured the si Maryland Ave. and Holden St., and will three 4-story brick and stone apar houses to cost about $45,000 each.

Kenosha, Wis.—The Park Ave. M. E. gregation, it is stated, contemplates er in the spring a new edifice to cost $25,0

Items marked thus give the names of parties awarded contracts.

Pa.—The St. Paul's United Evangeli- gregation, it is stated, will erect an to cost $70,000. Rev. J. W. Mes- Pastor.

'adelphia, Pa.—A building permit has ranted to Geo. Watson & Son, 907 N. ll St., to erect a brick dwelling at ocust St., at a cost of $25,000.

aukee, Wis.—It is reported that a) apartment house is to be erected at sin and Cass Sts. Frank C. Courtenay able to give further information.

SCHOOLS.

s Arranged Alphabetically by States.

'e Rock, Ark.—The Senate has passed appropriating $50,000 to establish a school.

Francisco, Cal.—See "Sewerage and e Disposal."

'erville, Cal.—The Co. Bd. of Superv., tated, is contemplating the erection of school.

blo, Colo.—The Directors of Dist. No. is stated, have accepted the plans sub- by Robt. S. Roeschlaub & Son, 52 King Denver, for the new high school, which be a 3-story and basement structure, s to be erected at Orman and Grant and Bway. and Michigan St. Prob- ost, $400,000. J. F. Keating, Supt. of Bldgs.

enwich, Conn.—The citizens have voted vor of erecting a high school to cost $100,000.

Haven, Conn.—G. T. Hewlett, Secy. duc., writes that the plans of Brown & Beren, 865 Chapel St., have been accept- r an 18-room school, to cost $58,200. for construction will probably be re- in April.

rrs, Conn.—J. F. Walsh, of Hartford, Treas., writes in regard to the erection brick dormitory at the Connecticut Agri- ral College, at Storrs (bids for which to have been opened on Feb. 27) that ontract will not be awarded to anyone esent. The General Assembly will act his in due time, and may or may not

ıldosta, Ga.—Algernon Blair, of Macon, reported, has received the contract to a school here, at $23,165, and Geo. Mc- & Son, of Valdosta, the contract for the ng of same, at $2,150.

con, Ga.—It is stated that plans will be ved until Mar. 10 by the State Normal l Bldg. Com., for the following build- A building for class room and labora- purposes, to cost $25,000; kitchen and g room building with second floor for itory, cost $15,000; central steam heat- plant for 7 college buildings; cost $10,- For further information address R. E. son, Chmn., Woodville, Ga.

llace, Idaho.—It is reported that the rs of Providence will erect a $30,000 l.

llinsville, Ill.—Bartlow & Kennedy, of St. Louis, it is stated, have prepared for an 8-room school to be erected here, cost of $18,000.

lesburg, Ill.—The Trus. of the Knox ge are contemplating the erection next on of a gymnasium, to cost about $25,-

icago, Ill.—The Bd. of Educ. has appro- ted $115,000 for the purchase of addi- l grounds and the erection of a 15-room tion and an assembly hall to the John Marsh School, at 99th St. and Escanaba

andinsville, Ill.—H. E. Hewitt, 24 Ar- Bldg., Peoria, it is reported, is prepar- plans for a brick and stone 8-room school h is to be erected at a cost of $18,000.

edora, Ill.—It is reported that H. E. itt, 24 Arcade Bldg., Peoria, Ill., is pre- ng plans for a 4-room school of brick stone, to cost about $10,000.

Roy, Ill.—It is stated that H. E. Hewitt, Arcade Bldg., Peoria, is preparing plans an annex to the high school, which is to $15,000.

eru, Ind.—It is stated that bids are want- by the Co. Comrs. until Apr. 5, for con- cting roads in Harrison Township. C. W. y, Co. Aud.

luncie, Ind.—C. E. Lambert, of Muncie, ool Trustee of Center Township, writes t plans are being prepared by Wing & urin, of Ft. Wayne, for the erection of itely School, and bids will be opened on il 3. According to reports, it will cost ,000.

ndianapolis, Ind.—Bids will be received . 14 by the Bd. School Comrs. for erect- a school on Rural St. Probable cost, ,000. Clarence Martindale, Archt., Indi- Trust Bldg.; John E. Cleland, Bus. Dir.

mes, Ia.—Bids will be received until Mar. y the Bd. of Trus. of the Iowa State Col- at Ames, for the erection of a central ting station and heating tunnel. Bids will received on the building complete, except ting, plumbing and electric wiring, sep- te bids to be submitted on the tunnel. udfoot & Bird, Archts., 712 Crocker Bldg., Moines.

rcadia, La.—The School Bd. has appoint- D. M. Atkins and Hon. J. Rush Wimberly a committee to secure a site, receive plans l specifications, and award the contract erecting a school in Dist. No. 1, the cost be about $22,000.

**Springfield, Mass.*—It is reported that D. A. DeVares has secured the contract to erect the Teachers' Training School, at about $35,879.

*The following are reported to be the bids received Feb. 10 for erecting the Technical High School (bidders of Springfield unless otherwise stated): Norcross Bros., of Worcester, $269,178; Central Constr. Co., of Worcester, $219,800; J. W. Bishop & Co., of Worcester, $198,722; Whitten & Haynes, of Boston, $195,543; L. H. Scott & Co., $195,000; H. P. Cummings & Co., of Ware, $192,987; Daniel C. Shea, $189,000; James F. Walls & Son, $188,955; W. H. Falvey, $182,200; R. L. Fosburg & Sons, of Boston, $181,900; Jere Shea & Son, $180,000; D. W. Mellen, 111 Dwight St., $175,000 (awarded contract).

The City Property Com., it is stated, will soon ask bids for ventilating, heating and plumbing the technical high school.

Wyandotte, Mich.—The citizens are reported to have voted in favor of issuing $50,000 bonds to erect a high school.

Kansas City, Mo.—The plans of C. A. Smith, Dwight Bldg., have been accepted for the Humboldt School, which is to be erected at 11th and Holmes Sts., at a cost of about $100,000.

**St. Louis, Mo.*—Hiram Lloyd Bldg. Co., 816 Olive St., it is stated, has secured the contract for the erection of Shields School, and the Kellermann Constr. Co., 510 Pine St., the contract for the 3-room addition to Dessalines School, the total cost of the 2 contracts aggregating about $191,265.

The School Bd. has approved plans for two 2-story schools, one to be erected in Frank Sigel Dist., and the other in Ellardsville Dist., the cost to be $148,800 and $154,000 respectively.

**Lincoln, Neb.*—Stevens Bros. Co., 2418 North N St., it is reported, has received the contract to erect the administration building on the State Univ. campus, at about $31,815.

Kearny, N. J.—Bids will be received, Mar. 13, by the Bd. Educ., for furnishing material and erecting an 8-room addition to School No. 4 and a 4-room addition to School No. 5, both on Kearny Ave., bids to be submitted separately for mason, carpenter and iron work, steam heating, plumbing, electric wiring, etc. J. B. Warren, Archt., 22 Clinton St., Newark. Wm. B. Ross, Secy.

Newark, N. J.—The Com. on Schoolhouses of the Bd. of Educ., it is reported, on Feb. 21 appointed the archts. who are to prepare plans for the 4 new schools which it is proposed erecting. The archts. appointed, and the schools for which they are to prepare plans are as follows: Hurd & Sutton, Prudential Bldg., for the 24-room school to relieve the Morton St. and other schools in that locality; Chas. P. Baldwin, 45 Clinton St., a 12-room addition to Elliott St. school, and a 12-room school to relieve Bergen St. and other schools in that locality; and Frank F. Ward, 203 Bway., N. Y. City, for a 16-room school to relieve S. 8th, S. 10th and 15th Ave. Percy B. Taylor, 122 Market St., was engaged as the ventilating and heating engineer on all 4 schools.

**Middle Village, L. I., N. Y.*—The following are the bids opened on Feb. 20 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction of School No. 87, at Middle Village, Queens Boro.: Buckley Realty Constr. Co., $103,000; Jos. Ohlhausen, $95,790 (awarded contract); Jas. MacArthur, $103,172; J. W. Bishop Co., $110,669; Richard H. Carman, $110,500; Thos. McKeown, $98,347; Richard E. Heningham, $98,000; Wm. Werner, $102,899; P. J. Walsh, $99,000; Tolmie & Kerr, $98,687, and Hartman & Horgan, $98,833.

Schenectady, N. Y.—It is reported that the City Clk. has been authorized to receive bids until Mar. 9 for the ventilating, heating, plumbing and electric wiring of the Eastern Ave. School.

Canton, N. Y.—Frost, Briggs & Chamberlain, 518 Main St., Worcester, Mass., it is stated, are preparing plans for the Scientific Building which is to be erected at the St. Lawrence Univ. with the $50,000 recently donated by Andrew Carnegie. Dr. Almon Gunnison, Pres.

New Brighton, S. I., N. Y.—The following are the bids opened on Feb. 27 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction of additions to and alterations in School No. 16, Richmond Boro.: Buckley Realty Constr. Co., Times Bldg., N. Y. City, $113,000; Thos. Cockerill & Son, $127,352; Hartman & Horgan, $120,833; Wm. Werner, $125,340; Walters & O'Connell, $124,737; Geo. Hildebrand, 1004 B'way, N. Y. City, $119,600; Philip Wolff & Son, $135,646, and Conrad Hewitt, Inc., $126,000.

Ithaca, N. Y.—Bids will be received until Apr. 3 by E. L. Williams, Treas. Cornell Univ., for constructing the N. Y. State College of Agriculture at the Univ.

Binghamton, N. Y.—Local press reports state that plans and specifications will be received until Mar. 12 for the Robinson St. School. Address Comr. Wilber, Chmn. Bldg. Com.

Salem, N. Y.—The taxpayers, it is stated, have voted to remodel the Washington Academy, at a cost of $11,000.

Albion, N. Y.—The Bd. of Educ. has adopted a resolution to submit to the people the question of issuing $110,000 bonds, to erect and furnish a Medina sandstone school.

New York, N. Y.—At the meeting of the Bd. of Estimate on Feb. 24, an appropriation of $3,000,000 was made to the Bd. of Educ. for new school buildings, sites and additions.

Bids will be received Mar. 13 by C. B. J. Snyder, Supt. School Bldgs., for installing ventilating and heating apparatus in De Witt, Clinton High School; also on same date for completing unfinished work for installing ventilating and heating apparatus in School No. 31, Boro. Manhattan.

The following are the bids opened on Feb. 27 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for the erection of 3 outside iron stairs at School No. 23, Manhattan Boro.: Frank C. O'Donnell, $10,100; Geo. Hildebrand, $10,346; Laurence J. Rice, $12,475; Wm. Werner, $10,752; Binney & Godfrey, $11,463; Tolmie & Kerr, $9,837; John Holl, 1971 First Ave., $7,500; Wm. Horne Co., $9,983; Patk. Sullivan, $10,876; Neptune B. Smyth, $9,267.

Jamestown, N. D.—Bids will be received Mar. 11 by the Bd. Educ. for erecting a 3-story brick and stone high school. Hancock Bros., Archts., Fargo; John G. Bensch, Clk.

Cleveland, O.—It is reported that the School Bd. archt. has completed plans for an addition to the Barkwill School, to cost $40,000.

Press reports state that bids will be received until Mar. 27 by the Bd. of Educ., for erecting an addition to Barkwill School.

East Liverpool, O.—The School Bd. is considering the erection of a high school, to cost between $50,000 and $75,000, and also the erection of a 4-room addition to the Klondike School, to cost about $12,000.

Cleveland Heights, O.—Bids will be received Mar. 20 by Wm. G. Phare, Clk. Bd. Educ. of Cleveland Heights School Dist., at 402 American Trust Bldg., Cleveland, for $28,000 school bonds.

Bids will be received Mar. 31 by Wm. G. Phare, Clk. Bd. Educ. of Cleveland Heights, at 402 American Trust Bldg., Cleveland, for furnishing material and erecting a 6-room addition to school on Lee Road. Geo. F. Hammond, Archt., 166 Euclid Ave., Cleveland.

Selma, O.—Bids will be received Mar. 23 by the Bd. Educ. of Selma Special School Dist. for furnishing material and erecting a 7-room school in said Dist. Robt. Elder, Clk.

Pitcairn, Pa.—The citizens voted Feb. 21 in favor of issuing $29,500 bonds for school purposes.

McKeesport, Pa.—The School Bd., it is stated, has rejected all bids received Feb. 27 for erecting the 4 schools and will readvertise.

Plymouth, Pa.—The high school at Plymouth, it is reported, has been destroyed by fire.

Philadelphia, Pa.—Bids will be received Mar. 7 by the Com. on Property at office of Bd. Educ. for erecting Southern Manual Training School on Broad and Jackson Sts.; appropriation, $330,000. A. F. Hammond, Secy.

Plans have been filed for the 4-story St. Paul School which is to be erected at 9th and Montrose Sts. E. F. Durang, Archt., 1200 Chestnut St.

Scranton, Pa.—Plans are being prepared for a brick school for the Church of the Holy Ghost by E. H. Davis, Archt., Connell Bldg.; cost, $10,000.

Coraopolis, Pa.—Robinson & Winkler, Park Bldg., Pittsburg, it is stated, are preparing plans for a school which is to be erected here, at a cost of about $20,000.

Providence, R. I.—The R. I. Society for the Collegiate Education of Women, it is reported, has purchased a site on Cushing St., adjoining the Women's College of Brown Univ., on which it is proposed erecting a gymnasium for the Pembroke Hall, $50,000 being available.

Nashville, Tenn.—The Trus. of the Roger Williams Univ., it is reported, are considering the rebuilding of the Univ., which was recently destroyed by fire.

Chattanooga, Tenn.—The Trus. of the Grant Univ., it is stated, have decided to erect a $25,000 building for the College of Liberal Arts.

Dallas, Tex.—The Baptists, it is stated, are contemplating the erection of a Univ. here, to cost about $75,000.

Houston, Tex.—The School Bd. has accepted the plans of L. S. Green, for the 2-story and basement 12-room school which is to be erected in the 5th Ward, at a cost of $20,000.

Sulphur Springs, Tex.—The Bldg. Com. of the Bd. of Educ. has adopted plans for a 2-story and basement brick school which it is proposed erecting, at a cost of $16,000.

Blacksburg, Va.—The Science Hall at the Virginia Polytechnic Institute, it is reported, has been destroyed by fire.

Walla Walla, Wash.—The School Bd., it is reported, has decided to erect a school, to cost $50,000.

Bethany, W. Va.—It is stated that Andrew Carnegie has agreed to give $20,000 to Bethany College for a library.

Buckhannon, W. Va.—The Trus. of the Wesleyan Univ., it is reported, have decided to rebuild the main building, which was destroyed by fire a few weeks ago, and are about to raise $60,000 for the purpose. Dr. John Wier, Pres.

Madison, Wis.—Cass Gilbert, 79 Wall St., N. Y. City, it is stated, has submitted plans for the $250,000 high school which the School Bd. intends erecting.

Milwaukee, Wis.—The Statutory Com. of the School Bd. has approved plans for the 14th Dist. School heating plant, and made minor changes in the plans for the heating plant for the North Division High School.

A power plant and a laundry, it is stated, are to be installed in the Milwaukee-Downer College. Ellen C. Sabin, Pres.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Perth Amboy, N. J.—Bids will be received Mar. 20, by the City Council, for the collection and disposal of ashes and garbage for term of 1 year. W. H. Fullerton, Street Comr.

New Brighton, S. I., N. Y.—Bids will be received Mar. 14 by Geo. Cromwell, Pres. Boro. Richmond, for furnishing material and sprinkling parts of certain highways in Boro. Richmond.

Rochester, N. Y.—Local press reports state that the following are the bids opened on Feb. 22, by the Bd. of Contract, for street Sprinkling for the year: Wm. H. Sours, $33,358; Geo. Bantel's Sons and Charles W. Hartung, $36,095; Grand Avenue Horse Co., $38,903; H. C. Schroeder, $41,056; Chas. L. Horn, $42,767, and J. J. Morrisey, $53,373.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

The Ogden, Utah, Sewer Pipe & Clay Co. is having plans prepared for a new building to be used for manufacturing all kinds of clay products.

The Dallas, Ga., Hosiery Mills contemplate erecting a 22x50-ft. building, and are in the market for a 10-h.p. engine and a 15-h.p. boiler.

The A. Bird Canning Co., Eagle Lake, Tex., has been incorporated with a capital of $10,000, and is in the market for boiler and canning machinery. A. Bird, St. Joseph, Mo., Mgr.

The Southern Sewer Pipe Co., Birmingham, Ala., intends to erect three addition 30-ft. kilns.

The South Side Mfg. Co., Petersburg, Va., manufacturer of baskets, boxes, crates, veneers, etc., expects to rebuild its recently burned plant. There will be a 160x45-ft. brick building, with a 35x66-ft. wing, and a 2-story, 32x90-ft. building.

The Colonial Beach, Va., Electric Light & Power Co. will erect an ice plant, telphone system and a steam laundry. W. S. P. Combs, Pres.

The Field-Brundage Co., Jackson, Mich., manufacturer of gasoline engines, will erect a 300x60-ft. fireproof building. L. H. Field, Jr., archt.

A bill has been passed in Kansas appropriating $200,000 for the erection and maintenance of a State oil refinery with a capacity of 2,000 bbl. daily.

The Star Electric Co., Binghamton, N. Y., has in course of erection a building about 60x90 ft. in size. It has not been decided whether to purchase an additional steam plant of about 30 h.p. or a producer gas plant and engine of the same capacity. The company will be in the market for several electric motors and a generator.

The Mansfiled, O., Lumber Co., whose plant was recently burned, will erect a 60x120-ft. building and install a power plant of 60 h.p.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Tucson, Ariz.—See "Water."

San Francisco, Cal.—The following are the bids for furnishing embankment near Daguerre Point, Yuba River, Cal., opened by California Debris Comn. at San Francisco on Feb. 17, 1905 (Capt. Wm. W. Harts, Corps Engrs., U. S. A., Secy.)—*a*, embankment fill, in place, 200,000 cu. yd., per cu. yd.; *b*, totals: H. J. Carstenbrook and J. D. Carstenbrook, Marysville, *a*, 16⅕ cts.; *b*, $33,000. Edwin Alex. Forbes, Marysville, *a*, 12½ cts.; *b*, $25,000. G. W. Cushing, San Francisco, *a*, 18⅞ cts.; *b*, $37,750. Lewis Moreing, Stockton, *a*, 16 cts.; *b*, $32,000. W. J. Schmidt, Berkeley, *a*, 17⅕ cts.; *b*, $35,000. North American Dredging Co., San Francisco, *a*, 22 64/100 cts.; *b*, $45,680, and A. B. Munson, Stockton, *a*, 12 4/10 cts.; *b*, $24,800.

New London, Conn.—The following are the bids for 332,000 building brick, opened Feb. 21 by Lieut.-Col. Chas. F. Powell, Corps of Engrs., U. S. A.—*a*, price per M. at New London; *b*, price per M. Islands: James R. Sayre, Jr., & Co., New York, N. Y., *b* (2 bids), $10, Plum; $9.50, Fisher's (ordinary building brick). New England Brick Co., Boston, Mass., *a*, $16 (ordinary building brick). C. T. Willard Co., New York, N. Y., *b*, $15.50 (hydraulic pressed, wire-cut). Charles Warner Co., Philadelphia, Pa., *b*, $15 (patent gray pressed brick). F. H. & A. H. Chappell Co., New London, *a*, $8.30 (ordinary building brick). Clay Product Supply Co., Philadelphia, Pa., *a* (2 bids), $22.50 (repressed); $19.50 (wire-cut). William Wirt Clark & Son, Baltimore, Md., *a*, $16.50 (hydraulic pressed, wire-cut). Warner-Miller Co., New Haven, *a*, $11.90 (hydraulic pressed red, wire-cut).

Washington, D. C.—The House has passed the river and harbor bill, which appropriates $17,234,657 for the purpose.

Chicago, Ill.—Bids will be received Mar. 15 by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for auxiliary mail conveyors and other apparatus in U. S. Post Office, Court House, etc.

Springfield, Ill.—See "Railroads."

Ft. Dodge, Ia.—It is stated that bids are wanted Mar. 22 for constructing 2 joint drainage ditches requiring about 200,000 cu. yds. excavation. H. S. Holmes, Co. Aud.

****Items marked thus give the names of parties awarded contracts.***

Clarion, Ia.—It is stated that bids are wanted Mar. 15 by E. M. Callender, Co. Aud., for ditchwork.

New Orleans, La.—Capt. J. F. McIndoe, Corps Engrs., U. S. A., writes that all bids opened on Feb. 18 for dredging channel near west shore of Sabine Lake, connecting Sabine and Neches Rivers with Taylor's Bayou, have been recommended for rejection, and new bids will probably be received. The following are the bids opened—*a*, 900,000 cu. yd. dredging, per cu. yd.; *b*, 1,500 lin. ft. creosoted wooden revetment, per lin. ft.: Rittenhouse Moore, Mobile, Ala., *a*, 16.3 cts.; *b*, $12. North American Dredging Co., San Francisco, Cal., *a*, 20 cts.; *b*, $15. Bowers Southern Dredging Co., Galveston, Tex., *a*, 18.5 cts.; *b*, $11.90, and Walter D. Keegan, New Orleans, *a*, 12.5 cts.

Bids are wanted Apr. 25 (readvertisement) for excavating approximately 55,000 cu. yd. by floating dredge. F. S. Shields, Secy. Sewerage and Water Bd.

Ft. Strong, Mass.—Bids are wanted Mar. 27 for furnishing material and constructing a rip-rap embankment of granite rock along east shore of reservation, at this post. Maj. John E. Baxter, Q. M. U. S. A., 170 Summer St., Boston.

Boston, Mass.—The Hoosac tunnel wharves in the Charlestown District, owned by the Boston & Maine R. R., are reported to have been destroyed by fire on Feb. 21.

Bids will be received by Col. W. S. Stanton, Corps Engrs., U. S. A., on Mar. 30 for rock excavation in Boston Harbor, as advertised in The Engineering Record.

Muskegon, Mich.—The County Bd. of Supervs. are stated to have authorized the construction of a dam on White River.

Shakopee, Minn.—It is stated that bids are wanted Mar. 10 for constructing ditch No. 1 and laterals Nos. 1, 2 and 3. J. H. Moore, Co. Aud.

Holly Beach, N. J.—H. Hewitt, Boro. Clk., writes that it was voted Feb. 21 to issue $25,000 bonds, to be used for improvements to the board-walk on ocean front.

**Ft. Totten, Willet's Point, N. Y.*—Capt. Geo. H. McManus, Q. M., U. S. A., writes that the contract for repairing a portion of long wharf at Ft. Totten (bids opened Feb. 7) has been awarded to J. M. Briggs, 17 Battery Pl., New York, for $3,482.

**New York, N. Y.*—The following are the bids opened on Feb. 21 by the Dept. of Docks and Ferries for a pier to be erected at foot of E. 35th St.—*a*, for building pier; *b*, for 7,860 cu. yd. rip-rap, per cu. yd.: Bernard Rolf, 39 Cortlandt St., *a*, $16,233; *b*, 44 cts. Snare & Triest Co., 39 Cortlandt St., *a*, $16,590; *b*, 45 cts. N. Y. State Constr. Co., 78 Broad St., *a*, $15,427; *b*, 45 cts.; total, $18,964 (awarded contract). Augustin Walsh, 96 Water St., *a*, $16,800; *b*, 45 cts. G. B. Spearin, 17 Battery Pl., *a*, $16,757; *b*, 45 cts.

Bids will be received Mr. 10 by Maurice Featherson, Comr. of Docks, for furnishing material, preparing and removing present pier, Old No. 19 East River, and constructing new pier bet. Maiden Lane and Burling Slip, to be known as pier No. 15, or Burling Slip Pier, West.

New Brighton, S. I., N. Y.—Bids will be received Mar. 14, by Geo. Cromwell, Pres. Boro. Richmond, for furnishing and delivering 9,000 cu. yds. 1½ in. broken stone of trap rock or Staten Island syenite, 1,100 cu. yds. ¾ in. size of same material and 4,200 cu. yds. of screenings of same material, to be delivered upon roads in various portions of Boro Richmond.

St. George, S. I., N. Y—Bids will be received Mar. 13 by Maurice Featherson, Comr. of Docks, N. Y. City, for furnishing material, preparing and removing present ferry structures at St. George, Boro. Richmond, and building new ferry structures in connection with new St. George Ferry Terminal and for dredging thereat.

Wapakoneta, O.—Press reports state that at a joint meeting of the Comrs. of Auglaize, Logan and Shelby Counties, it was decided to grant the petition for building the municipal joint ditch, which has been pending for sevral years. The ditch will be about 17 miles in length and will drain land in the three counties named.

Philadelphia, Pa.—The following are the bids opened on Feb. 16 by the Superv. Archt., Treas. Dept., Washington, D. C., for a lookout gallery at the U. S. Post Office at Philadelphia (bidders all of Philadelphia): John Price, $4,145; D. A. McClelland, $3,823; Cramp & Co., $5,330.

Allegheny, Pa.—See "Sewerage and Sewage Disposal."

Bremerton, Wash.—Bids will be received until Apr. 15 by Mordecai T. Endicott Ch. Bureau of Yards & Docks, Navy Dept., Washington, D. C., for furnishing a 5-ton electric traveling crane at Navy Yard, Puget Sound, Wash.

Quaco, N. B.—It is stated that bids are wanted Mar. 7 by the Dept. Pub. Wks., Ottawa, Ont. (Fred. Gelinas, Secy.), for constructing an extension to the east pier at this place.

**Toronto, Ont.*—The Bd. of Wks. is stated to have on Feb. 21 awarded to the Cayuga Lake Cement Co., Ithaca, N. Y., the contract for the year's supply of cement at $1.58 per bbl. About 15,000 bbls. will be required. The Massillon Co., Massillon, O., is reported to have secured the contract for paving brick, at $27.40 per M.

Panama.—The Engineering Com. has submitted to the Isthmian Canal Comn. at Washington, D. C., plans for the construction of the Panama Canal. It recommends for adoption a plan for a sea-level canal, with a bottom width of 150 ft., and a minimum depth of water of 35 ft., with twin tidal locks at Miraflores, whose usable dimensions shall be 1,000 ft. long and 100 ft. wide, at a total estimated cost of $230,500,000. This estimate includes an allowance of administration, engineering, sanitation, and contingencies, amounting to $38,450,000, but without allowance for interest during construction, expense of zone government, and collateral costs, and water supply, sewers, or paving of Panama or Colon, which last items are to be repaid by the inhabitants of those cities. It estimates that a sea-level canal can be completed within from 10 to 12 yrs. from present time.

The following are the bids opened by the Isthmian Canal Comn. at Washington, D. C., on Feb. 28 for 25 pneumatic rock drills, (*a*) size 24 E, (*b*), size 25 F: McKrannen Drill Co., New York, N. Y., *a* $5,687.50, *b* $5,937.50; Sullivan Machinery Co., New York, N. Y., *a* $6,739.50, *b* $8,278.85; Wood Drill Works, Paterson, N. J., *a* $5,494, *b* $6,410; Compressed Air Machinery Co., San Francisco, Cal., *a* $8,225, *b* $8,859; Ingersoll-Sergeant Drill Co., New York, N. Y., *a* $6,591, *b* $7,989; Ricks Drill Co., San Francisco, Cal., *a* $7,500; J. M. Rogers, Gloucester, N. J., *a* $9,653, *b* $10,420; Chicago Pneumatic Tool Co., Chicago, Ill., *a* $6,261.25, *b* $7,186.25; Rand Drill Co., New York, N. Y., *a* $6,635, *b* $7,964.30; Jeffrey Mfg. Co., Columbus, O., *a* $3,750, *b* $4,125.

PROPOSALS OPEN.

For proposals see pages 82, 92, 112 and 117.

Bids Close.	WATER WORKS.	See Eng Record.
Mar 6.	Supplies, Syracuse, N. Y.	Mar. 4
Mar. 6.	Ford City, Pa. Adv. Feb. 11 to Mar. 4.	Feb. 11
Mar. 6.	Pumping plant, Iowa Falls, Ia. Adv. Feb. 18, 25.	Feb. 18
Mar. 7.	Tower, etc., Greenbush, Minn.	Mar. 4
Mar. 7.	Milwaukee, Wis.	Feb. 25
Mar. 7.	Pipe, Ft. D. A. Russell, Wyo.	Feb. 25
Mar. 8.	Hydrants, etc., New York, N.Y.	Feb. 25
Mar. 8.	**Mains, Ft. DuPont, Del.** **Adv. Feb. 11 to 25.**	**Feb. 11**
Mar. 8.	Filtration, Pittsburg. Pa. Adv. Jan. 28 to Feb. 25.	Jan. 28
Mar. 10.	Pipe, etc., Minneapolis, Minn.	Mar. 4
Mar. 10.	Bishop, Cal.	Feb. 18
Mar. 11.	Basin, Lorain, O.	Feb. 18
Mar. 13.	Pumping Plant, Bellingham, Wash.	Mar. 4
Mar. 13.	Pipe, Ft. Flagler, Wash.	Mar. 4
Mar. 13.	Pipe fittings, etc., Winnipeg. Man., Adv. Feb. 25	Feb. 25
Mar. 13.	Stop-cock boxes, Cleveland. O. Adv. Feb. 25.	Feb. 25
Mar. 14.	System, Mansfield, La. Adv. Mar. 4.	Mar. 4
Mar. 14.	Pipe, etc., Cincinnati, O.	Feb. 25
Mar. 15.	Tank, Osborne, Kan.	Feb. 25
Mar. 16.	Callicoon Depot, N. Y.	Feb. 25
Mar. 17.	Pipe and cstgs, Cincinnati O. Adv. Feb. 18 to Mar. 4.	Feb. 18
Mar. 18.	Pipe, Washington, D. C. Adv. Mar. 4.	Mar. 4
Mar. 20.	Meeker, Colo. Feb. 18 to Mar. 4.	Mar. 4
Mar. 20.	Laying pipe, Holden, Mass.	Mar. 4
Mar. 20.	North Bay, Ont.	Feb. 25
Mar. 20.	Boyce, La., Adv. Feb. 25	Feb. 25
Mar. 21.	Engine, Toronto, Ont. Adv. Feb. 25 and Mar. 4.	Feb. 25
Mar. 21.	Well, Ft. Caswell, N. C. **Adv. Feb. 4 to 18.**	Feb. 4
Mar. 23.	Boilers, Barnesville, O.	Mar. 4
Mar. 23.	Alpena, Mich., Adv. Mar. 4	Mar. 4
Mar. 25.	Oakes, N. D.	Mar. 4
Mar. 25.	Pipe, valves, etc., Ft. Assinniboine, Mont.	Mar. 4
Mar. 28.	Coal pocket, etc., Atlantic City, N. J. Adv. Feb. 25, Mar. 4.	Feb. 25
Mar. 29.	Ft. Sill, Okla, Ter.	Mar. 4
Mar.31.	**Meters, Pocatello, Idaho.** Adv. Jan. 28 to Feb. 18.	**Jan. 28**
Mar. —.	Clare, Mich.	Mar. 4
Mar. —.	Sylacauga, Ala.	Feb. 28
Mar. —.	Smith's Grove, Ky.	Jan. 7
Apr. 1.	Irrig., Usk. Wash	Dec. 24
Apr. 10.	Main supply canal, Belle Fourche, S. D. Adv. Feb. 18 to Mar. 4.	Feb. 18
Apr. 10.	Pipe & Spcls, Winnipeg, Man. Adv. Feb. 18.	Feb. 18
Apr. 18.	New Orleans, La. Adv. Feb. 11 to Mar. 4.	Feb. 11
Apr. 25.	Canal, pipe, etc., N. Orleans. La., Adv. Feb. 18 to Mar. 4.	Feb. 18
May. 1.	**Shirley, Ind.**	**Feb. 11**

SEWERAGE AND SEWAGE DISPOSAL.

Mar. 6.	**Washington, D. C.** **Adv. Feb. 11.**	**Feb. 11**
Mar. 7.	Saratoga Springs, N. Y.	Mar. 4
Mar. 7.	Holly Springs, Miss. Adv. Feb. 18.	Feb. 18
Mar. 8.	Brooklyn, N. Y.	Mar. 4
Mar. 8.	Columbus, O., Adv. Feb. 25.	Feb. 25
Mar. 10.	Bishop, Cal.	Feb. 18
Mar. 11.	Des Moines, Ia. Adv. Feb. 25.	Feb. 25
Mar. 11.	Lorain, O.	Feb. 18
Mar. 14.	Winnipeg, Man. Adv. Mar. 4.	Mar. 4
Mar. 15.	Brooklyn, N. Y.	Mar. 4
Mar. 20.	North Bay, Ont.	Feb. 25
Mar. 21.	Des Moines, Ia.	Mar. 4
Mar. 25.	Oakes, N. D.	Mar. 4
Mar. 29.	Ft. McIntosh, Tex.	Mar. 4
Apr. 18.	New Orleans, La. Adv. Feb. 11 to Mar. 4.	Feb. 18

BRIDGES.

Mar. 7.	Albion, Ind.	Feb. 25
Mar. 8.	Des Moines, Ia.	Feb. 25
Mar. 11.	Elk River, Minn.	Mar. 4
Mar. 13.	Lebanon, O.	Mar. 4
Mar. 13.	San Bernardino, Cal.	Feb. 11
Mar. 15.	Crawfordsville, Ind.	Feb. 25
Mar. 18.	Des Moines, Ia.	Mar. 4
Mar. 20.	Cleveland, O.	Mar. 4
Mar. 22.	**Providence, R. I. (2 prop)** Adv. Feb. 18 to Mar. 4.	**Feb. 18**
Mar. 23.	Washington, D. C. Adv. Feb. 25 and Mar. 4.	Feb. 25
Mar. 25.	Bentonville, Ark.	Feb. 25
Mar. 30.	Manistee, Mich.	Feb. 25
Apr. 4.	Columbus, Ga.	Mar. 4
Apr. 4.	Spokane, Wash.	Mar. 4
Apr. 4.	Alma, Neb.	Feb. 18
Apr. 4.	**Goldendale, Wash**	**Feb. 11**
Apr. 6.	Wabash, Ind.	Feb. 25

PAVING AND ROADMAKING.

Mar. 6.	Syracuse, N. Y.	Mar. 4
Mar. 7.	Irvington, N. J.	Mar. 4
Mar. 7.	Paola, Kan.	Mar. 4
Mar. 7.	St. Louis, Mo.	Feb. 25
Mar. 7.	Bucyrus, O.	Feb. 25
Mar. 7.	Rockville, Ind.	Feb. 18
Mar. 7.	**Broad Ripple, Ind.**	**Feb. 11**
Mar. 8.	Brooklyn, N. Y.	Feb. 25
Mar. 9.	New York, N. Y.	Mar. 4
Mar. 10.	Cincinnati, O.	Feb. 18
Mar. 11.	Watertown, Wis.	Mar. 4
Mar. 13.	Bedford, Ind.	Feb. 18
Mar. 14.	Des Moines, Ia.	Mar. 4
Mar. 14.	Cambridge, O., Adv. Feb. 25	Feb. 25
Mar. 15.	South Bend, Ind.	Mar. 4
Mar. 15.	Rensselaer, Ind.	Feb. 25
Mar. 15.	Elizabeth, N. J.	Feb. 25
Mar. 16.	Bloomfield, Ind.	Feb. 18
Mar. 18.	Cincinnati, O.	Feb. 25
Mar. 20.	Clairton, Pa.	Mar. 4
Mar. 20.	Helena, Mont.	Mar. 4
Mar. 20.	Jacksonville, Fla.	Mar. 4
Mar. 20.	Cincinnati, O.	Mar. 4
Mar. 21.	Bessemer, Ala.	Mar. 4
Mar. 24.	Cincinnati, O.	Mar. 4
Mar. 23.	Jerry City, O.	Mar. 4
Mar. 25.	Lancaster, Pa.	Mar. 4
Mar. 25.	Cincinnati, O.	Mar. 4
Mar. —.	Tacoma, Wash.	Mar. 4
Apr. 5.	Peru, Ind.	Mar. 4
Apr. 18.	La Crosse, Wis.	Feb. 25

POWER, GAS AND ELECTRICITY.

Mar. 7.	Philadelphia, Pa.	Mar. 4
Mar. 7.	Washington, D. C.	Feb. 25
Mar. 8.	Baltimore, Md.	Feb. 25
Mar. 10.	Stillman, Minn.	Feb. 18
Mar. 14.	Washington, D. C.	Feb. 18
Mar. 15.	New York, N. Y.	Mar. 4
Mar. 17.	Jefferson Barracks, Mo.	Feb. 25
Mar. 20.	**Washington, D. C.** **Adv. Feb. 11.**	**Feb. 11**
Mar. 21.	Norwalk, Ohio. Adv. Feb. 25 and Mar. 4.	Feb. 18
Mar. 23.	Alpena, Mich., Adv. Mar. 4.	Mar. 4
Mar. 23.	Dayton, O.	Mar. 4
Mar. 25.	Portsmouth, N. H.	Feb. 25
Mar. 27.	Santa Monica, Cal.	Mar. 4
Mar. 28.	Dover, N. J.	Mar. 4
Mar. —.	Sylacauga, Ala.	Feb. 25
Apr. 3.	Lakeport, Cal.	Mar. 4
Apr. 3.	**Cape Charles, Va.** Adv. Feb. 25.	**Feb. 25**
Apr. 11.	Shreveport, La.	Feb. 18
Apr. 12.	Lockport, Ill. Adv. Feb. 18.	Feb. 18
Apr. —.	**Ft. Valley, Ga.**	**Jan. 21**
May 1.	**Shirley, Ind.**	**Feb. 11**
———.	Branchville, S. C.	Feb. 18
———.	**Laconia, N. H.** **Adv. Jan. 28.**	**Jan. 28**

BUILDINGS.

Mar. 6.	U. S. Soldiers' Home, Washington, D. C. Adv. Feb. 4 to Mar. 4.	Feb. 4
Mar. 6.	Church plans, Portsmouth, O. **Adv. Feb. 18.**	Feb. 18
Mar. 6.	P. O. Bldg., Battle Creek. Mich., Adv. Jan. 21, 28.	Jan. 21
Mar. 7.	Jail, Dublin, Ga.	Feb. 25
Mar. 7.	School Bldgs., Philadelphia, Pa. Pa.	Feb. 25 Mar. 4
Mar. 7.	Court House, Hot Springs, Ark., Adv. Feb. 18, 25.	Feb. 18
Mar. 7.	**P. O. Bldg., Findlay, O.** Adv. Jan. 21, 28.	**Jan. 21**
Mar. 8.	Htg. school, Ames, Ia.	Mar. 4
Mar. 8.	School, Delaware, Wis.	Feb. 25
Mar. 8.	Signal House, etc., San Francisco, Cal.	Feb. 25
Mar. 8.	Post Bldg., Ft. Baker, Cal.	Feb. 18
Mar. 8.	School, Niles, O. Adv. Feb. 18, 25.	Feb. 18
Mar. 8.	**Stone work for Pub. Bldg., Washington, D. C., Adv.** Adv. Feb. 11 to Mar. 4.	
Mar. 8.	Hospital, Central Islip, N. Y.	Feb. 18
Mar. 8.	**P. O. Bldg., Muskegon, Mich.**	**Jan. 28**
Mar. 9.	Jail, New Albany, Miss.	Mar. 4
Mar. 9.	Htg. school, Schenectady, N.Y.	Mar. 4
Mar. 9.	Post Office, London, Ont.	Mar. 4
Mar. 9.	School, Columbia, S. C.	Feb. 25
Mar. 9.	School plans, Athens, Ga.	Feb. 18
Mar. 9.	Pub. Bldg., Little Rock, Ark.	Feb. 18
Mar. 9.	Sashes, blinds, etc., Panama.	Feb. 18
Mar. 9.	School Jicarilla, N. Mex.	Feb. 18
Mar. 9.	**Post Bldg., Key West Barracks, Fla.** Adv. Feb. 11 to Mar. 4.	Feb. 11
Mar. 9.	**Court House, Elbow Lake. Minn.**	Feb. 11
Mar. 9.	**Htg. U. S. Hospital, Savannah, Ga., Adv. Feb. 11, 18.**	Feb. 11
Mar. 10.	School, Macon, Ga.	Mar. 4
Mar. 10.	Post Bldgs., Jefferson Barracks, Mo.	Feb. 18
Mar. 10.	**School, Freeport, Ill.**	**Feb. 11**
Mar. 10.	**Post Bldgs., Ft. Rodman,** Mass., Adv. Feb. 11 to Mar. 4	Feb. 11
Mar. 10.	**Post Bldgs., Ft. Ontario, N.** Y., Adv. Feb. 11 to Mar. 4.	Feb. 11
Mar. 11.	School, Jamestown, N. D.	Mar. 4
Mar. 11.	Police station, Newburg Heights, O.	Feb. 18
Mar. 11.	**Naval Prison, New York, N. Y.**	**Feb. 11**
Mar. 12.	School plans, Binghamton, N.Y.	Mar. 4
Mar. 13.	Schools, New York, N. Y.	Mar. 4
Mar. 13.	Schools, Kearny, N. J.	Mar. 4
Mar. 13.	City Hall, Oskaloosa, Ia.	Feb. 25
Mar. 13.	School, Cleveland, O.	Feb. 18
Mar.13.	**P. O. Bldg., Hammond, Ind.** Adv. Jan. 28, Feb. 4.	**Jan. 28**
Mar. 14.	School, Indianapolis, Ind.	Mar. 4
Mar. 14.	Remod. Jail, Grand Forks, N. D.	Feb. 18
Mar. 14.	**School, Kearny, N. J.**	**Feb. 11**
Mar.14.	**P. O. Bldg., Moberly, Mo.** Adv. Jan. 28, Feb. 4.	**Jan.**
Mar. 15.	Engine house, Omaha, Neb.	Mar.
Mar. 15.	Bus. Bldg., Cedar Rapids, Ia.	Mar.
Mar. 15.	Storehouse, Ft. Monroe, Va.	Mar.
Mar. 15.	School, Starbuck, Minn.	Feb.
Mar. 15.	School, Chippewa Falls, Wis.	Feb.
Mar. 15.	Y. M. C. A. Bldg., Seattle Wash.	Feb.
Mar. 15.	Plumb. Pub. Bldg., Nat. Soldiers' Home, Va.	Feb.
Mar. 15.	Church, Clyde, Kan.	Feb.
Mar. 15.	**Md. Insti. plans, Baltimore, Md.**	Feb.
Mar. 15.	**Univ. plans, Washington, D. C.**	Feb.
Mar. 15.	Jail, Camden, N. J.	Feb.
Mar. 16.	Bank, Sioux City, Ia.	Mar.
Mar. 17.	Wagon shed, Ft. Caswell, N.C. Adv. Feb. 18 to Mar. 4.	Feb.
Mar. 20.	Union Depot, Meridian, Miss.	Mar.
Mar. 20.	Y. M. C. A. Brandon, Man.	Mar.
Mar. 20.	Post Bldg., Chickamauga Park, Ga., Adv. Mar. 4.	Mar.
Mar. 20.	School, Lascruces, N. Mex.	Feb.
Mar. 20.	**P. O. Bldg., Elizabeth City, N. C., Adv. Feb. 4, 11**	Feb.
Mar. 21.	Hospital, New York, N. Y.	Feb.
Mar. 21.	**Armory, Rochester, N. Y.** Adv. Feb. 18, 25.	Feb.
Mar. 21.	**P. O. Bldg., Laredo, Tex.** **Adv. Feb. 4.**	Feb.
Mar. 22.	Pub. Bldg., Detroit, Mich.	Mar.
Mar. 22.	Post Office, Grand Rapids, Mich.	Mar.
Mar. 23.	School, Selma, O.	Mar.
Mar. 23.	School, Baton Rouge, La.	Feb.
Mar. 23.	**P. O. Bldg., Sherman, Tex** **Adv. Feb. 4, 11.**	Feb.
Mar. 27.	School Cleveland, O.	Mar.
Mar. 27.	City Hall, Alpena, Mich.	Mar.
Mar. 27.	**P. O. Bldg., Lebanon, Pa.** Adv. Feb. 11, 18.	Feb.
Mar. 28.	Library, Cincinnati, O.	Mar.
Mar. 28.	**P. O. Bldg, Superior, Wis.**	Feb.
Mar. 31.	School, Cleveland Heights, O.	Mar.
Mar. —.	Theatre, Philadelphia, Pa.	Mar.
Mar.—.	**School, Klamath Falls, Ore.**	Jan.
Apr. 1.	Court House, Baraboo, Wis.	Feb.
Apr. 1.	**Y. M. C. A. plans, Binghamton, N. Y.**	Feb.
Apr. 3.	Bus. Bldg., Cincinnati, O.	Mar.
Apr. 3.	School, Ithaca, N. Y.	Mar.
Apr. 3.	School, Muncie, Ind.	Mar.
Apr. 3.	Court House, Kentland, Ind.	Feb.
Apr. 3.	P. O. Bldg., Macon, Ga.	Feb.
Apr. 3.	Court House, Newton, Ind.	Feb.
Apr. 5.	**Court House plans, New Orleans, La.**	Dec
Apr. 6.	Post Office, Marblehead, Mass. Adv. Mar. 4.	Mar.
Apr. 15.	Court House, Grundy, Va.	Feb.
Apr. —.	School, New Haven, Conn.	Mar.
———.	School Bldg. material, etc., Phoenix, Ariz.	Feb.
Jun. 15.	Court House plans, New Orleans, La.	Feb.

MISCELLANEOUS.

Mar. 6.	Garbage Disposal, Long Island City, L. I., N. Y.	Feb.
Mar. 6.	Dredging, Philadelphia, Pa.	Feb.
Mar. 6.	Rem. wrecks, Boston, Mass.	Feb.
Mar. 6.	**R. R. tunnel, New York, N. Y.**	Feb.
Mar. 7.	Pier extension, Quaco, N. B.	Mar.
Mar. 7.	Ditches, Storm Lake, Ia.	Feb.
Mar. 8.	Cement, Brooklyn, N. Y.	Feb.
Mar. 8.	Dredging plant, Detroit, Mich.	Feb.
Mar. 9.	Grand stand, Dayton, O.	Feb.
Mar. 9.	**Steel shed, N. Orleans, La.** Adv. Feb. 18, 25.	Feb.
Mar. 10.	Ditch, Shakopee, Minn.	Mar.
Mar. 10.	El. Ry. franchise, Redbluff, Cal.	Mar.
Mar. 10.	Piers, New York, N. Y.	Mar.
Mar. 10.	El. Ry. franchise, Oroville, Cal.	Feb.
Mar. 11.	Elevators, Portsmouth, N. H.	Feb.
Mar. 13.	Ferry structures, St. George, S. I., N. Y.	Mar.
Mar. 13.	St. Ry. franchise, Bakersfield, Cal.	Feb.
Mar. 14.	Broken stone, etc., New Brighton, S. I., N. Y.	Mar.
Mar. 14.	St. sprinkling, New Brighton, S. I., N. Y.	Mar.
Mar. 14.	Mach. tools, Washington, D. C.	Feb.
Mar. 14.	Cement, Wheeling, W. Va. Adv. Feb. 18 to Mar. 4.	Feb.
Mar. 15.	Ditch, Clarion, Ia.	Mar.
Mar. 15.	Mail conveyors, Chicago, Ill.	Mar.
Mar. 15.	El. Ry. wrk, Bennington, Vt.	Mar.
Mar.15.	El. Ry. franchise, Modesta, Cal.	Mar.
Mar. 15.	Street Signs, Columbus, O. Adv. Feb. 25, Mar. 4.	Feb.
Mar. 15.	**Cable, Washington, D. C.**	Feb.
Mar. 15.	El. Ry. work, Pittsfield, Mass.	Feb.
Mar. 15.	Cement, Peterborough, Ont.	Feb.
Mar. 15.	**Dam, etc., Los Angeles, Cal.** Adv. Jan. 21 to Feb. 18.	Jan.
Mar. 17.	**Dredge, etc., St. Louis, Mo.** **Adv. Jan. 21 to Feb. 4.**	Jan.
Mar. 18.	Cement, etc., Wilmington, N.C. Adv. Feb. 18 to Mar. 4.	Feb.
Mar. 20.	Garb. Disp., Perth Amboy, N. J.	Mar.
Mar. 20.	**Ditch., Macon, Mo.**	Feb.
Mar. 20.	Levee, England, Ark.	Feb.
Mar. 21.	El. Ry. franchise, Los Angeles, Cal.	Mar.
Mar. 22.	Drainage work, Ft. Dodge, Ia.	Mar.
Mar. 24.	El. Ry. franchise, Benicia, Cal.	Mar.
Mar. 25.	Grading, etc., New Orleans, La.	Feb.
Mar. 25.	Wharf, New Orleans, La.	Feb.
Mar. 27.	Riprap embankment, Ft. Strong, Mass.	Mar.
Mar. 30.	Rock excav., Boston, Mass. Adv. Mar. 4.	Mar.
Mar. 31.	**El. Ry., Shanghai, China**	Oct.
———.	Hauling stone, Catskill, N. Y. Adv. Feb. 18.	Feb.
Apr. 4.	Ditch, Fairmont, Minn.	Feb.
Apr. 10.	Channel work, Bermuda	Feb.
Apr. 15.	Electric crane, Bremerton, Wash.	Mar.
Apr. 25.	Dredging, New Orleans, La.	Mar.
———.	R. R. ties, Atlanta, Ga. Adv. Mar. 4.	Mar.
———.	**El. Ry. franchise, Yazoo City, Miss.**	Feb.
May 10.	**Ditch, Stevens Point, Wis.**	Feb.

****Items marked thus give the names of parties awarded contracts.***